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SURVEY OF THE FOOD PROCESSING INDUSTRY IN THE ASIA REGION[1/]

by

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PART A - CEREALS AND MEAT

SUMMARY OF THE ANNUAL PRODUCTION OF THE MAIN ASIAN CEREAL CROPS

The twelve month periods of 1975 or 1975-76 have been taken as a typical agricultural year for Asia. The tonnages of the cereal crops have been reported or estimated as follows:

	Tons mn	%
Milled or pounded edible rice - (Paddy 308mn)	163	40.9
Wheat	105	26.3
Maize	50	12.5
Millet and Sorghum ...	46	11.5
Barley	31	7.8
Oats	4	1.0
Rye	neg	-
	399	100.0

2. The figure of 163mn tons of rice is an estimate, 53 per cent yield of white rice from the official figure of 308mn tons of Paddy. Paddy is the only cereal crop that cannot be fed directly from threshing to men or to their livestock. The essential processing of paddy to extract the rice results in large reductions in weight from the threshed and dried grains.

3. It is therefore unrealistic to equate a ton of paddy to a ton of any other cereal in a total of available food or feed grains.

4. A high proportion of these cereal crops are subsistence food eaten by the growers. The crops are either never weighed, or if weighed in rural areas, no records are available for statistical use. Crop yield figures are mainly derived from measured yields of very small typical

areas multiplied up by using surveyed figures of the known arable areas. The margin for error is appreciable.

FOOD PROCESSING AND THE GRAIN TRADE

5. In southern and south-east Asian countries, the importance of food processing is extremely high in the case of paddy and rice because of the high processing losses which do not occur with the other major crops: Wheat, maize, barley, millets and sorghum. These grains can be relatively simply ground to food in the villages or processed in urban areas by modern machinery, all with very low rates of loss.

6. Storage losses can and do occur for all these grains when stored in humid climates, but only paddy is grown in always humid climates so it is the cereal most at risk.

7. Imports of rice and wheat are carried out at government level, the main suppliers being the T.N.Cs of the U.S.A.

8. Relatively small quantities of rice and wheat are exported by one Asian country to another Asian country, a few per cent of the crop, except wheat exports by Turkey. Only Thailand, Pakistan and Burma now have appreciable surpluses of rice, which are dwindling, to export. China exports some rice in exchange for about double the weight of wheat, which is so much cheaper.

9. Indonesia is the world's largest importer of rice from Asian countries. It now needs upwards of two million tons a year, despite a modest per capita annual consumption of about 125kg, and some of it is supplied by the U.S.A.

10. Against a world production of about 200mn tons of white rice annually, only 5 - 7mn tons cross national boundaries. The U.S.A. exports about 2 million tons of white rice.

11. Secondary processing of white rice is of extremely small importance because of the demand for it as basic food. The Japanese can easily produce a surplus of their japonica rice and they use it for fancy foods and alcoholic drinks.

PADDY AND RICE

Relative importance versus other cereals

12. White rice extracted from paddy forms 41 per cent of the tonnage of all food and stock-feed cereals grown in Asia. There, paddy as a crop is 308mn tons a year out of the total of 544mn tons of all cereals cropped, which is 57 per cent; wheat, 105mn tons, is next highest.

13. White rice is the only cereal in the world of which large quantities, possibly 45 per cent in total, are not available for livestock feed. It is not even available in Asia in sufficient quantities to feed the population adequately. Statistical trends indicate that the population is rising faster than its production of its basic food - rice, in the densely populated south and south-east regions of Asia.

14. The average yield of white rice extracted from the 308mn Asian paddy crop is only 53 per cent, to give the figure of 163mn tons in paragraph 1.

15. There is no quick substitute for rice for remote rural populations accustomed to growing and eating their own rice. They are in the position of the potato-eating Irish of the 19th century, who had no knowledge or equipment to grow other crops or to grind wheat, or to bake bread from flour, even if these foods could reach them from overseas.

16. Wheat, Asia's second cereal crop, is about 105mn tons a year, of which 50mn tons is grown and eaten in the middle latitudes of China, while 32mn tons are grown and eaten in the northern areas of India and Pakistan below the Himalayas. Turkey with 15mn tons, much of it exported presumably to Russia, accounts for all but 6mn tons of the rest of the Asian wheat crop.

17. Asia's third cereal crop, maize, amounts to 50mn tons, half grown in China, with India, Indonesia, Thailand and the Philippines being significant producers, and all for home consumption and stock-feeding.

18. Neither Asian wheat nor maize can appreciably alleviate the shortage of white rice in Asia.

Dealing with the incipient rice shortage

19. The first quick solution to the incipient and really serious shortages of rice in Asia is not to plan to grow more paddy, a long-term answer, but to improve rural milling equipment. A small modern mill to service 500 ha or so will increase white rice output by 40 per cent if it replaces hand-pounding or out-of-date power mills.

20. It will also provide 100 tons or so of bran, a natural protein-oil concentrate ideal for blending with bulk foods for cattle, or for direct feeding to poultry.

21. The second solution is not even irrigation but the growing of two high-yield variety paddy crops per monsoon, instead of the normal one, on millions of hectares of existing unirrigated paddy-fields.

22. The expensive long-term solutions, involving years of delay instead of months, are to open up new paddy areas and to provide year-round irrigation of existing paddy-fields, both to enable almost continuous cultivation at three crops a year.

Realism on rice yields from paddy

23. Published and widely accepted figures for the processing yields of rice from paddy are based on the performances of the best multi-stage mills, modified sometimes to allow for the much lower yields of hand or foot pounding and for the numerous single-stage mechanically driven mills of 19th century design.

24. Field studies in S.E. Asian countries, where the round-grain japonica varieties of paddy are seldom grown, have shown that single-stage milling does not give a rice yield above 50 per cent. This figure has not been improved upon by repeated tests in the Engineering Department of the International Rice Research Institute at Los Baños.

25. Data on manual pounding of paddy, both on yields and man-(or woman) hours per ton, vary very widely indeed. However, one field trial gave a yield of under 40 per cent of cleaned and sifted edible white rice requiring about one man (or woman) hour per kg of edible rice.

26. Single-stage milling has largely replaced hand pounding in Asia and multi-stage milling is very slowly replacing the single-stage method. Accurate data is not available but it seems likely that only 15 per cent of Asian paddy, including most of the japonica-type paddy, grown in Japan, is processed in multi-stage mills. This leads to the probability that only 46mn tons of the 308mn tons of Asian paddy is fairly efficiently milled with rice yields on paddy of 65 to 70 per cent. The overall yield of rice is therefore estimated at 163mn tons in the 1975 season, 53 per cent on paddy.

27. Official countrywide figuree of milling yielde range from 60 to over 70 per cent, which means that the availability of home-produced rice can be over-estimated by from 11 to 32 per cent, except in very advanced areae where multi-etage milling is general.

PROCESSING OF PADDY TO EDIBLE RICE

Drying the wet paddy grains

28. Freshly threshed paddy graine in the generally humid areas of Aeia contain from 18 to 28 per cent of moisture. Theee grains start rotting within three days at upwards of 18 per cent of moieture content, and even at 18 per cent eome deterioration etarts after a few days. For etorage, the moisture content has to be reduced to 14 per cent, correeponding to atmoepheric humidity of 70 per cent; better etill, to 13 per cent moisture corresponding to atmoepheric humidity of 65 per cent.

29. Humidity below 70 per cent doee occur in the dry eeason during a few hours around noon, but dry paddy in etore slowly absorbe moieture through its tough hull (or husk). Periodic re-drying is essential for good storage during the long monthe between one harveet and the next.

30. To dry 120 tons of wet paddy at 28 per cent moieture down to dry paddy at 14 per cent requires the evaporation of 20 tone of moisture, and results in 100 tons of etoreable paddy. 104.5 tons of paddy at 18 per cent moisture will also dry down to 100 tons of 14 per cent paddy.

31. Traditionally, paddy has been harvested in dry sunny weather at relatively low moieture contents, around 18 per cent. One clear day of hot sunehine will dry a layer of this paddy down to safe etorage moisture content. The paddy is spread on a dry surface to a thickness of 2 to 4cm and it is oonetantly raked over, to re-expose the bottom grains.

32. Under such conditions, the grain reaches a temperature too hot to hold, perhaps 65°C on ocoasion. Such high temperatures over-dry the grain and make it brittle, causing internal cracks, known as "eun cracks" in the rice grains. This condition increases the breakage rate in subsequent milling and causes some absolute loss by additional pulverisation of the rice grains; the powdered rice appears with the bran.

33. The best method of drying rice is by passing warmed and therefore fairly dry air through it at about 40°C. Large quantities of air are required because one cubic metre of such air only removes very few grams of moisture.

34. The usual methods of warming atmospheric air to reduce its humidity to below 65 per cent are furnaces burning light oil; and electric resistance heaters.

35. A much cheaper method is to burn the hulls or husks blown out of the hulling or shelling stage in multi-stage mills. Hulls do not burn freely unless in air suspension and an adaptation of the bagasse burning boilers at cane sugar mills is being used where bagasse is fed into the top of the boiler furnace where it burns to ash as it falls.

36. Hulls for fuel are only available at multi-stage mills and these mills are heavily out-numbered, in most Asian countries, by single-stage mills. The inextricable mixture of crushed rice, bran and hulls discarded by these mills is barely combustible in any conditions.

37. Paddy should be dried relatively slowly in artificial driers to avoid a case-hardening effect with outer layers of grain over-dried before the heat can penetrate to the inner layers. Rapid drying also can cause a form of "sun-check" with internal cracks forming.

38. Slow drying is far more important for paddy than for cereals which will later be milled to flour. Cracks due to high drying temperatures for a short period are unimportant before processing in a flour mill or even for hand-pounding of maize.

Manual pounding

39. The traditional method of extracting rice from paddy, for thousands of years, is to place a few handfuls of freshly dried or re-dried paddy in a large wooden mortar made from a trunk of a tree. Heavy wooden poles, up to two metres long, are used to pound the grain. It is then taken out and sifted to remove loose hulls, bran flakes and pulverised rice; the remainder is again pounded and sifted until the desired degree of whiteness has been achieved.

40. An alternative method, quite common in Bangladesh, is to pound the paddy in the mortar with a large wooden pestle fixed to one end of a horizontal bar. The bar is pinned at one point of its length so that it acts as a lever, foot-operated at the opposite end from the pestle.

41. More elaborate methods exist, such as using hardwood grindstones, but all are extremely laborious and production seems to be about 1-kg of rice per operator-hour for well whitened and cleaned rice.

The single-stage huller-polisher - Phase 1 mechanisation

42. Thie polisher is known under several names, Engleburg and Kiskesan being the commonest. It has a single horizontal shaft, power-driven, and surrounded by a perforated steel ecreen inside a cast-iron casing.

43. The ehaft carries varied fittinge to force the paddy, which entere the annular epace between the shaft and ecreen, through the holee in the ecreen to remove both hulls and bran, if so set. It can be also set to remove bran from brown rice, or hulls only from paddy.

44. Like the old manual automobile gearbox, - "it is brutal but it works".

45. Single-stage milling ie by far the commonest mechanised method for extracting rice from paddy in Asia. One estimate is that ae many as 250,000 such mille are in use, excluding China and Japan. Their capacitiee are mostly in the 250 to 500-kg of paddy an hour range, and they use 6 to 12 H.P. of diesel/electric power to operate.

46. Most of thie power is converted to heat in milling and in breaking up much of the rice. The rice emerges too hot to hold in the hand, and breakage of half of the grains of the recovered rice is accepted ae normal.

47. This mill wae designed in the late 19th century for coffee grinding. It ie cheap and eaey to make, operate and maintain. Little epecific data is available but it is estimated that the 250,000 mille deal with 100mn tons of paddy a year, averaging 400 tons per mill againet a capacity of 500 to 1,000 tons per mill for 2,000 operating hours a year.

48. The eocial and economic benefits brought by these mille are immense. Mostly owned by private sector millere, they are etrategically sited to minimise the farmers' work of transporting sacks of paddy to them and returning home with half that weight of rice.

49. A half-ton mill produces 250-kg of rice an hour with a crew of two men; 125-kg per man-hour. It probably takes a woman an hour to produce 1-kg of rice from 2-kg (or more) of paddy. A typical farm family of six neede at least 2-kg of white rice a day, involving two hours of very heavy work. The mill produces the 2-kg in half-a-minute.

50. It is probable that the optimum yield of rice from raw paddy, 50 per cent for the single-stage mill, is higher than for pounding. It would need a lengthy study to establish a fair average figure for pounding yields at farm households.

51. A generally aocepted figure for the labour requirements for a 2 ton crop of threehed and sun-dried paddy, a typical yield from 1-ha, is 1,000 man-hours. The 2 tons of paddy can be expected to yield up to 1 ton of rice at milling. It therefore takes ae much labour to produce and sun-dry paddy ae to pound that paddy to white rice; about 1,000 hours of labour at each stage.

52. The introduction of eingle-etage power milling has halved the farm family's labour input per ton of white rice. This labour-saving has been achieved gradually by natural economic pressures from farm families wanting to be relieved of the daily heavy drudgery of pounding and sifting paddy to rice.

53. The effect can only be beneficial to family life and diet. Most farmers have small gardens on which the families can raise roots, green vegetablee and fruit, and where poultry can be kept, if time allows after the daily white rice supply is assured and when there is no field-work.

54. At transplanting and harveeting, all working members of the family are in the fields, where the ecope for labour saving, to reduce work, mostly done by women, is immense.

55. The eerious disadvantagee of the eingle-stage mill are that its yield is not more than 500-kg of rice from a ton of paddy, against about 700-kg for first-olass milling. Assuming again the estimate that theee mills deal with 100mn tons of paddy a year (excluding Japan and China), they destroy 20mn tons of rice a year. They also fail to recover any of the 10mn tons of the bran between the hulls and the rice grains. Their diecarded hulls, mixed with pulveriaed bran and rice, are useless as fuel and cannot be fed even to poultry, because of the high eilica content of the hulls.

56. Theee mills can be regarded as Phase 1 of the mechanisation of rice extraction, 19th century maohines now up-dated to early 20th century with diesel or electric drive instead of the original steam engines with wood-fired boilers.

57. If a single-stage half-ton per hour mill were replaced by modern equipment of the same hourly capacity for the same 400 tone of paddy a year, but at 70 per cent rice and 10 per oent bran yields, the contrast in yields would be:

Single-stage milling output from 400 tons of paddy -		
50% yield, 200 tons rice @ $300 per ton	...	$ 60,000
Modern equipment output from 400 tons of paddy -		
70% yield, 280 tons rice @ $300 per ton	...	$ 84,000
10% yield, 40 tons of bran @ $100 per ton	...	$ 4,000
		$ 88,000
Value of increased annual output	...	$ 28,000

58. The modern equipment would use the existing mill compound, building, power supply, etc., but would require much less power to operate the process. Ideally, the by-product of 80 tons of clean hulls should be used to dry the paddy, particularly that harvested in the wet season when sun-drying is not fully effective.

59. The much higher yields of modern equipment, 40 per cent more rice plus bran worth another 3 per cent in terms of rice, would in practice attract farmers from longer distances, and one unit of more intensively used modern equipment could take over from two old units and deal with 800 tons of rice a year - well within its capacity, and in that case, the unit of modern equipment would have an output valued at $176,000, replacing two old units with a total output of $120,000.

60. The modern unit then increases the sales value of the output from processing 800 tons of paddy by $56,000 a year, an amount enough to interest any agricultural bank to lend a miller the money to buy a modern unit.

Multi-stage mills - Phase 2 mechanisation

61. The basic difference between single and multi-stage mills is that the hulls (or husks) are first removed from the paddy, producing "brown" rice which is rice with its bran coating intact. The bran weighs from 9 to 12 per cent of the brown rice. A second stage of milling removes all the bran and often the outer layer of rice as well. It is usual for the hulls to be discarded in some manner. The bran, a concentrated stock-feed, high in protein and fats, sells easily at about 30 per cent of the price of white rice.

62. Most of these mills are of 1 to 2 tons of paddy an hour capacity, but there is no technical barrier to building much larger mills, if economic paddy supplies can be assured.

63. The logistics of moving paddy to mills range from porters or farmers carrying it in sacks, to large boats being loaded near the fields for cheap and easy river transport to a distant jetty, down-stream, of a really large mill, 10 to 25 tons an hour capacity.

64. The paddy supply problem of most big mills (even a 1 ton unit rates as "big" in comparison with single-stage mills) is that they must draw some of their paddy from distances too great for the small farmer to cover. Even the 1 ton mill needs 1,500 to 2,000 tons of paddy a year for single-shift operation.

65. All-weather roads are still very much the exception in most paddy-growing areas and scope for cheap river-transport is limited even in river deltas.

66. Except in the relatively few lightly populated areas where paddy can be grown and harvested using powered machinery on estates, the farm family, on its half to one hectare of paddy, eats a high proportion of its single paddy crop a year. The farm families eat their own vegetables, roots, tubers and fruit, plus fish from canals, rivers and the sea, when obtainable.

67. It is clearly most desirable that all paddy should be processed to give the optimum yields possible of rice and bran, and that the natural pressures of modern processing equipment, sited near at hand, should persuade farmers to give up using both manual pounding and single-stage milling.

68. A modern half-ton unit is capable of dealing with say 800 tons of paddy a year on single shift working. This is the production of about 280-ha, or less, of high yield variety (HYV) paddy.

69. In the ideal layout of a circular area of paddy-fields, the distance from the perimeter to the centre for processing is about 1-km. It is well worth even the perimeter farmer's effort to transport all his paddy to the mill if he receives 700-kg instead of 500-kg of rice in return for each ton of his paddy.

70. A farmer growing 2 tons of paddy a year, yielding 1 ton of rice at 50 per cent yield, needs 750-kg of rice at least to feed his family and himself. His surplus, up to 250-kg, worth about $75 is cash income for a family of six persons. If he is in economic range of modern equipment,

he will receive 1.4 tons of rice, giving a surplus of 650-kg, so raising his family's cash income from rice to nearly $200.

71. In paddy growing regions, there are three to four paddy-farm families to each non-farming family. In one form or another, the spending of three or four farm cash incomes reaches the average non-farming family, increasing the annual circulation of farm spending passing through its hands from about $260 to $700 a year.

72. IRRI at Los Baños is working out a technology for obtaining two crops each monsoon, instead of one, on ordinary unirrigated paddy-fields. Basically, their thinking is to use the new early maturing paddy seed varieties and to direct-seed the first crop after the initial thorough wetting of the soil early in the monsoon. As this crop is harvested in mid-monsoon, 110 days later, the second crop is transplanted between the stubbles, the second harvest being in dry weather, well after the end of the monsoon.

73. There is now the possibility of two crops a year to be transported for processing, with the first harvest overlapping the transplanting of the second crop.

74. It is therefore more important than before that all farmers not on roads or rivers should have the minimum distance to transport their paddy for efficient processing. This calls for numerous small units, each with high yields of rice and good recovery of the bran for stock-feeding.

Milling machinery in multi-stage mills

75. The commonest types of machinery in the "big" mills, and also in replacements for single-stage mills, suffer from severe drawbacks if used for indica paddies which have long grains in contrast to almost round japonica varieties.

The rubber roll mill

76. A rubber roll mill is often used for hulling (shelling) the paddy to produce brown rice and hulls, separately. Each mill has two rolls mounted on heavy horizontal steel shafts in parallel.

77. The rolls are of steel or cast iron, each with a thick layer, like a tyre, of rubber or synthetic material about 2cm thick, to give an overall diameter of 20 to 30cm, the milling width being 15cm or more. The rolls are driven at high speeds in opposite directions, inwards and downwards, with a small gap between them. One roll rotates at a higher speed than the other.

78. Paddy is fed by gravity into the gap, which is very slightly less than the average grain diameter. Each grain is briefly nipped and rotated about one to one-and-a-half turns in the gap. This peels off the hull and only a few per cent of the grains of brown rice appear as broken; some or all of the breaks seen may be due to "sun-crack", overheating while drying.

79. This is an excellent yield of whole grain brown rice. It calls for accurate adjustment of the gap, when the diameter of a grain of paddy is only 2mm and rapid wear is occurring on the roll surfaces. It is not difficult to maintain a correct gap.

80. A minor drawback of this method of milling is that a blast of air into the gap is needed to keep the rolls and rice cool; much of the milling power consumed is converted to heat.

81. The main drawback is that no roll-covering material has yet been produced that stands up to the abrasive action of the indica paddy hulls. Experienced millers have given the average life of a pair of rolls ranging from 20 to 70 tons on indica varieties of paddy. On single shift, a weekly replacement of the rolls is common.

82. The market price of a pair of replacement rolls is high; $40 to $200 have been quoted, the top price being a black-market one forced up by import restrictions. Replacing the thick, hard covering material needs specialised equipment. Worn rolls may have to be sent many hundreds of kilometres to the nearest retreading plant.

83. Each rubber roll mill therefore requires many sets of expensive rolls, most of them in transit to and from the retreading plant.

Under-runner disc sheller

84. This widely used type of machine is expensive, heavy, has a long life and is cheap to maintain. It is a variation on the horizontal pairs of millstones with centre feed, one stone stationary, one revolving, which have been used for many centuries, driven by hand, water or wind power. The sheller uses synthetic stones, easily replaceable, locally made of carborundum and a binder. There are no sharp grooves of the kind used to cut and break up the grains, as in flour milling.

85. Power consumption is about 4 H.P. for 1 ton of paddy per hour. This amount of power means generation of heat, and a contribution to the breakage of grains, in the constricted space between the two stones.

The centrifugal

86. A little-used type of sheller is known as the "centrifugal". Its merit is that it is very cheap to buy. Incoming paddy is given a sharp impetus, centrifugal, so that it flies across the machine and the impact is then powerful enough to detach the hulls. It has been described as even more dsstructive of the rice grains than the Engleberg type of machine which itself breaks about half the rice grains.

Whitening/polishing

87. Whitening and polishing are successive processes, but polishing is only used when high degrees of whiteness and smoothness of surface are required for the top grades of rice. A single operation is sufficient to remove the bran for nearly all the rice consumed locally.

88. A sscond or third operation, polishing, tends to remove the surface layers of rice. This rice powder emerges with the bran and represents human food degraded to stock-feeding and at a much lower market price than rice.

89. Ther' are three main typee of machines used for whitening or polishing indica brown rice. One is a development of the old single-stage huller-polisher, but set for brown rice instead of paddy. The main differences are the addition of a powerful blower to keep the machine and the rice cool. The air blast is applied through a hollow main shaft, on which are mounted some of ths milling components. The air emerges through holes in the walls of the shaft to cool the surrounding rice.

90. Two operations on brown rice are common in multi-stage mills, whitening and polishing, using the same type of machine. Power consumption is very high for such light operations; bran has the consistency of hard wax, much softer than white rice. Each operation requires about 10 H.P. per ton of paddy per hour, or 14 H.P. in terms of a ton of white rice processed per hour.

91. The power is dissipated as heated air because the cooling of the rice is effective.

92. The other two types are similar in action but one operatee with a vertical driving shaft and the other with the shaft horizontal. In both, the brown rice is subjected to abrasive surfacee under pressure.

93. A fourth variety, used for round japonica grains in Japan, removes the bran by mutual abrasion, a rumbling processe under direct pressure involving a rotating cylinder.

Grain breakages in multi-stage paddy mills

94. A recent report on 80 "medium" and "large" mills, all multi-stage by implication, in South East Asia, produced data which showed that the percentage of broken grains of saleable white rice ranged from 30 to 49 per cent. These figures agree with field studies, which also showed that single-stage mills produced white rice with 50 and higher percentages of brokens, but also with nearly 30 per cent of the rice grains pulverised and discarded.

95. The 80 multi-stage mills gave overall yields of whole and broken, but saleable, white rice ranging from 64 to 67 per cent on paddy. When the broken grains are separated out for sale, they fetch about 60 per cent of the whole grain rice prices.

THE FUTURE, AND PHASE 3 MECHANISATION

96. No amount of expenditure on crops and on agro-based industry, other than on paddy and its processing to rice, will solve the food problems ahead in south and south-east Asia. Furthermore, the growing and processing of the other cereals are well established as are their relatively simple methods and equipment for processing into food and storing it where grown, or elsewhere.

97. Currently, population is increasing faster than paddy production in South and South-east Asia. The north-eastern countries of Asia, perhaps including China, where paddy is cultivated, have developed means of making proper use of the new high yield variety japonica paddy seeds and they have machinery suited to it which is comparable with flour mills in terms of low processing loss.

98. Scenarios 1 and 2 on page 132 of the "Draft World-Wide Study of Agro-Industries 1975-2000" are clearly unacceptable, depending as they do on "trends" and on "stationary" per capita food production.

99. Scenario 3 calls for a high compound rate of increase, 7.8 per cent a year, for added value in the agro-food industry in the developing countries. In terms of 1975 dollar in purchasing power, the increase is from 100 to 654.

100. Data show that south and south-east Asia grows about 160mn tons of paddy on 80-ha of cropped areas, some double-cropped with irrigation; 2.0 tons per ha per crop, annually. With existing varieties of the new

HYV seeds and using the eseential correctly applied inputs of chemicale and fertilieers, (which will neceesitate field equipment currently under development), the average crop can be gradually raieed to 4.0 tons per ha. The current optimum crops are from 5 to 6 tons per ha.

101. IRRI has shown the poseibilities of growing two heavy crope a year without irrigation, using only monsoon rain on about 35mn ha. Early matu ing varieties of HYV paddy seeds plus their appropriate inpute have to be used. These techniques could raise the average paddy crop from the preseat 2.0 to 4.0 tons per ha and produce two crops instead of one; 8 tons which replace 2 tone per ha of paddy-field annually. On the 35mn ha of field, this means 280mn tone inetead of 70mn tons, but it puts the equivalent of another 35mn ha into cropping.

102. On the other 45mn of cropped hectares, output can also be doubled to give 180mn tone instead of 90mn tons. The overall crop increaee on the present paddy-fields is 160 to 460mn tons a year, without further capital expenditure on new irrigation projects.

103. Value added by the mechanical processing of paddy to rice has an additional increase to offer. Aeeuming the preeent yield of 53 per cent of rice or paddy to continue, the additional rice output rises from 85mn tons to 244mn tons.

104. If modern processing equipment takes over, even in remote rural areas, with a rice yield of 70 per cent, the output of white rice rises from the present 85mn tons to 322mn tons, in the ratio of 100 to 379. This is a compound interest rate of almost 5.5 per cent over 25 years.

105. This rate of increaee is far ahead of any poesible rate of increaee in Asian populations, whose ratee tend to drop quickly, ae in Korea and Malaysia, when the GNP per capita riees. Current country-wise population increases range from about 1.6 to 3.0 per cent, roughly in inverse ratio to their GNPs per capita.

106. The implications of the above figures on the more intensive use of exieting paddy-fields, but without spending thousands of dollars per ha on new irrigation, are that south and south-east Asia food probl ms can be solved using techniques which can start coming into wide use in 1979.

107. Once the basic food, rice, is assured, and in plenty, national and reserve stocks of milled rice are built up and flood-proofed, particularly in areas known to be liable to flooding, expansion of crops will have to be slowed down. Flood and general emergency reserves of paddy are not available for issue, if they cannot be pounded or milled very quickly.

108. Rural incomes will be higher, and money will therefore become available for setting up secondary industries, and also services, in rural areas, which can expand indefinitely. The 7.8 per cent expansion of Scenario 3 is practicable in Asia, starting with paddy and rice to produce surpluses to finance secondary rural industries.

109. The secondary benefit calculations to show how agricultural surpluses finance industrial development are given, in précis form, on pages 38-41 of the Draft World-wide study of the Agro-Industries 1975-2000.

Phase 3 mechanisation

110. A consortium of manufacturing companies in Europe has built and tested a half-ton paddy an hour modular unit which is designed to decorticate paddy in two stages, rather than to mill it. Pressures exerted on the grains - first, in removing the hulls, and then the bran, are minimal. The results are:

i) A high yield of head (whole grain) rice and correspondingly low breakages.
ii) Little abrasion of rice grains to powdered rice going into the bran.
iii) Negligible heating of the grains being decorticated so that fans are unnecessary.
iv) Low power consumption.
v) Very long life of the novel materials used to decorticate the hulls and the bran.
vi) Low maintenance and repair costs.
vii) The modular construction to fit standard containers for shipping and also to enable batteries of units to be built up compactly to 1, 1½ or 2 ton of paddy capacity which occupy little space in a building.

111. The general views of the consortium are to licence part-manufacture of the modular units in user countries which have adequate engineering resources and capabilities, once local successful operations on sufficient scale have been attained.

112. Paragraphs 57-60 give the calculations for the extra value added to each 800 tons of paddy as $56,000, when two single-stage mills are replaced by one modular decorticating unit. This double replacement is justified if the old mills are unnecessarily close together.

113. If the paddy-growing areas are small and scattered, then each 200 ha., even less, may need its own processing unit, to avoid unacceptable amounts of transportation of paddy.

Turn-over of loans for purchasing Phase 3 machinery

114. Agricultural banks or other organisations selling modular decorticating units as replacements for existing single-stage mills could expect to be paid back, by the additional rice yield alone, before 200 tons of paddy have been processed.

115. If these units can be intensively used, then the turnover of agricultural bank funds available for loans to paddy co-operatives, and to private millers, would be several times a year.

MEAT PROCESSING

116. In the four countries of south-east Asia dealt with in Part B of this paper - Nepal, Malaysia, Thailand and Indonesia - meat eating customs vary widely. Apart from religious beliefs, the amount of meat eaten per capita is related to the cash income of a family, and to the possibility of catching fresh and salt water fish for themselves or buying it cheaply from fishermen.

117. Meat includes red meat, and white or poultry meat with the associated eggs. Poultry have higher conversion ratios of feed to meat than bovines, goats or sheep.

118. With cash incomes rising per family, during Phase 3 mechanisation of the paddy and rice industries, in both rural and urban areas, the demands for more varied diets are inevitable and desirable. Emphasis should be to encourage poultry-keeping in the cereal growing areas. Beef cattle do not do well in the humid tropics below the 1,000m level and goats destroy the hill forests.

119. The daily requirements of protein, as calculated by nutritionists, have fallen heavily in the past fifteen years, and in India millions of the people have never eaten meat, even when they can afford to buy it. Pulses supply their essential protein.

120. Red meat is a middle and upper income urban luxury in south-east Asia. Most of it is butchered and eaten within the same 24 hours, partly because of lack of cold storage equipment.

121. Consumption of poultry meat is not uncommon in rural, but meat-eating, arsas but it is still very low where fish is available. Fish are caught even in flooded paddy-fields and the Tilapia breed can be farmed in funded fields.

122. In the developed countries, consumptions of poultry meat and eggs, per capita, have increased enormously in the past thirty years, while average red meat consumption has not changed much. The real cost of poultry has fallen. It used to be said that a chicken for the pot cost a day's wages of a local working man, all over the world. Due to intensive work on feeding, breeding and factory processing, the cost of the factory-frozen chicken can now be earned within an hour of semi-skilled labour.

123. Quickly maturing modern poultry, all developed from Asian jungle-fowl, thrive in tropical conditions under good management and proper feeding.

124. A farmer growing 4 tons a year of paddy and taking his share of bran from the paddy co-operative, has say 350kg of stabilised bran a year, 1-kg daily, to fsed his wife's poultry. This alone is enough concentrate feed for at least one good-sized chicken in ths pot each week, plus incidental eggs and chickens for sale and processing.

125. To summarize, and in view of the UNESCO commitment at their March 1978 sssion to encourage industry in rural rather than the already over-crowded urban areas, the emphasis on meat processing should be on white meat, poultry and eggs.

126. These products can be produced by paddy farm familiss in particular, once they obtain free stabilised bran from their paddy crop; the same bran, most of which is currently destroyed in processsing paddy to rice in south and south-east Asia.

PART 'B' - NEPAL

SUB-REGIONAL PAPER

CEREALS AND MEAT IN NEPAL

CEREALS

The 1972-73 figures for the production of food-grain crops in Nepal are shown, as reported, in the table below:

	000 tons
Milled and pounded Rice, estd. (Paddy 2.0lmn tons)	819
Maize	822
Wheat	312
Millet	134
Barley	25
Total edible grains ...	2,112

2. These crop figures are taken from a comprehensive report - "Food Grains in Nepal", of April 1978, by a member of the staff of the Tropical Products Institute of London, seconded to the Nepal Food Corporation (NFC).

WHITE RICE

3. The report does not give a figure for the total of white rice produced, except as an estimate of 62kg per capita consumed annually and a statemsnt that about 100,000 tons of rice are exported a year.

4. The official 1971 census figure for the Nepalese population in books of reference is 11,289,000 and the NFC report gives an estimate of 2 per cent annual rise in population. The 1972-73 average population is now assumed to have been 3 per cent higher, 11.62mn., than the census figure.

5. An estimate of the production of white rice for 1972-73 is now attempted:

	Tons White Rice
(a) Rice eaten @ 62kg/cap, 11.6mn persons	719,200
(b) Rice exported	100,000
(c) Total rice eaten and exported ...	819,200
(d) Multi-stage mills, 60, averaging 4,000 tons of paddy a year; rice yield 67%	160,800
(e) Single-stage mills, 1,800, averaging 400 tons paddy a year; rice yield 55%	396,000
(f) Total milled rice produced ...	556,800
(g) Pounded rice produced (c - f) ...	262,400
(h) Total rice produced (as c) ...	819,200

6. It is assumed that there were no significant changes in end-of-period stocks, a reasonable belief because of general shortage of good storage space and the rapid deterioration that takes place in rice when stored for more than a few months.

7. The estimate appears to give a strong indication that large quantities of paddy are still being pounded, because the outputs per mill are typical of similar mills in other countries; higher, if anything.

8. FAO reports also give the production of paddy in 1972-73 as 2.01mn tons from 1.104mn ha; 1.80 tons per ha. The NFC report gives production per ha by areas, figures which vary widely from each other, ranging from 1.6 in the Terai up to 3.2 tons per ha in the Katmandu valley.

9. Seed requirements for transplanted paddy are low, about 25kg per ha of crop. If all the crop is transplanted, the paddy crop used for seed would be about 28,000 tons. Some part of the crop may be from broadcast seed, needing about 100kg per ha, so the seed requirements are now estimated at 50,000 tons. Only a small proportion is of specially grown HYV seeds.

10. Before allowing for unexplained losses, etc., the paddy available for processing to rice in 1972-73 was therefore 1.96mn tons. The rice yield has just been estimated at 819,000 tons, which is only 42 per cent on paddy.

11. The 1,860 small and large mills have been estimated to have processed a total of 960,000 tons of paddy, which leaves 1.0mn tons for pounding to produce 262,400 tons of rice, para.5 (g), at the unlikely low yield of 26 per cent. There is a major discrepancy here but a common one in statistics dealing with paddy and rice. If pounding had a yield of 50 per cent rice from paddy, a rather high figure, the 1mn tons of paddy calculated as pounded would have yielded 500,000 tons of rice, a difference of 237,600 tons still to be accounted for.

12. Parboiling of paddy is a fairly common practice in Nepal, despite the unpleasant aroma normally caused. The mill yields have been increased, for the estimate, above those for raw paddy milling (50 per cent) because parboiling not only reduces processing loss in grain breakage but causes some of the bran to be absorbed by the rice grain. The overall effect is several percentage points gain in rice yield. Exact figures on how much of the paddy is parboiled are not available and anyway could only be a very rough estimate.

OFFICES VISITED IN KATMANDU

13. In collecting data for this report, discussions were held in the following offices in and near Katmandu from Sunday, August 27th, to Wednesday, August 30th:

Agricultural Development Bank.
The Balaju multi-stage paddy mill.
The UNDP/FAO/UNIDO offices.
The British Embassy.
The Nepal Food Corporation.
The Food Research Laboratory.
The Indistrial Services Division, Balaju.
The British Gurkha Resettlement Scheme.

Some offices were shut on Sunday, and the British Embassy was shut on Monday as well, - the British autumn holiday.

PER CAPITA CONSUMPTION OF CEREALS

14. The NFC report gives the following per capita figures of human consumption of cereals in the year 1971-72, and beside these figures are the corresponding total figures of consumption based on a population of 11.6mn., and also the total production figures used in para.1.

	Kg/cap.	Human Food in Nepal, Tons-mn	Grain Production Tons-mn.
White rice	62.1	0.71	0.82
Maize	51.3	0.59	0.82
Wheat	17.4	0.20	0.31
Millet	9.3	0.11	0.13
Barley	3.2	0.04	0.03
	143.3	1.65	2.11

DIFFERENCES BETWEEN CONSUMPTION AND PRODUCTION

15. The export of 0.10mn tons of white rice covers the difference between rice eaten and rice processed in Nepal. The large differences between maize and wheat produced and eaten as human food is unlikely to be due to exports but may represent seed usage and stock-feed

16. A likely main cause for the rice discrepancy in para.11 is hinted at in the NPC report - "the illicit movement of paddy over the border" into India. The length of this border is given as 600km. In 1972-73 India was short of rice and was said to be importing rice illicitly from Bangladesh.

17. More recently, India's wheat and rice production had risen to the extent of creating storage problems and prices fell below those ruling in Nepal. The 1978 monsoon floods in the U.P. Behar, West Bengal, and countries east have been deep and extensive enough to have damaged the monsoon (aman) paddy crop besides destroying stocks and damaging paddy mills. Indian paddy and rice prices must be rising, making export more attractive.

THE PRIORITIES TO INCREASE THE PRODUCTION OF WHITE RICE

18. Officers with whom discussions were held in Katmandu and on the Balaju Industrial Estate were unanimous that the paddy milling machines used in Nepal and available for purchase in India, were unduly destructive of rice. Further imports of single-stage and multi-stage mills of current designs were undesirable but apparently inevitable.

19. The scope for increasing the area under paddy was very limited and double-cropping of paddy was rarely possible. The cold weather climate in any area of Nepal did not permit of a cold weather paddy crop, but wheat was increasingly being grown.

20. In the eastern paddy areas of the country where monsoon rain is higher than in the west, a second paddy crop might prove to be possible during and after the monsoon, using the IRRI techniques described in Part A, paras. 101-102, particularly in the eastern Terai.

21. It was also unanimous that better transport facilities, that is more hardened roads, more and better storage for paddy and rice were also desirable. It is quicker and more cost-effective to change milling machinery and to abolish pounding of paddy than to build the thousands of kilometres of roads needed over rough or mountainous country.

22. For example, if all single-stage mills were replaced by small multi-stage mills of designs in use at present, the 1972-73 level of production of paddy, 2.01mn tons, would yield 1.35mn tons of white rice, at 67 per cent yield, plus about 0.15 to 0.20mn tons of bran for stock-feeding. This rice would provide a per capita allowance of 116kg a year.

23. Modern equipment for decorticating, rather than milling, paddy and brown rice, now under full-scale trials, is expected to increase the rice yield to 70 per cent, nearly all of it whole grain (head) rice, plus a high quality of bran, free of pulverised rice. (Part A, para.110)

24. The top priority, the easiest and least expensive one, will be to replace two single-stage mills by one half-ton an hour decorticator, which will recover its capital cost in extra production before 200 tons of paddy have been milled. The high yields will make it economic for farmers to bring in their paddy from longer distances. The cutting out of the heavy labour of pounding will compensate for the effort of transporting paddy to the mill and some rice back home for eating.

25. Electric power and diesel oil are particularly expensive in Nepal, due to the high cost of fuel transport. The power used for current milling equipment bears little relation to the <u>useful</u> work done on the paddy, a two-stage decortication process which should not break the grains or remove the outer layer of the rice grains as well as the bran.

The degree of whitening and polishing desirable

26. There is a certain cachet noticeable in Asia in eating rice that is really white, with all traces of bran and the highly nutritious embryo removed. The dominantly wheat-eating countries similarly demand unnaturally white flour and bread.

27. There is also a growing tendency for maize to be milled to a degree that nothing but a particularly pure form of starch, corn-flour, is left for food.

28. Officials in Katmandu brought up this matter and they want paddy mills in which the amount of whitening can be readily controlled to maximize the quantity of rice produced and its potential nutritional value.

29. The whitening-polishing equipment in the paddy decorticating unit, Part A para.110, has ten stages of whitening or polishing, of which up to eight stages can be removed easily and rapidly to convert a highly polished product to one with little bran on it and most of the embryos in position in the grains of rice.

30. A sample of bran taken from the Balaju paddy mill shows clearly white rice powder mixed with the brown bran. The texture of the mixture is quite different from pure rice bran.

31. This mill uses equipment almost entirely manufactured in Nepal, at Chitwana, to an Indian pattern. The capacity is one ton of paddy an hour and the motor driving all its units is rated at 20kw.

32. The final stage, whitening-polishing, uses the air-cooled development of the 19th century Engleberg or Kiskesan. Rice comes out in two forms - the head (whole grain) rice which includes 12-14 per cent of brokens by weight, and all brokens.

33. It appeared that upwards of one-third of all the rice produced was brokens, which is the general expectation. The rice was over-polished too, the evidence being the powdered rice visible in the bran.

The Balaju paddy mill

34. This mill is on the Balaju Industrial Estate, five km out of Katmandu. It is a 1-ton of paddy an hour mill, multi-stage, the equipment being almost entirely built in Chitwana, Nepal, the extra items being manufactured in India. The design was all Japanese.

35. This mill appears to be regarded as one of the best managed mills in Nepal, so three visits were paid to it and much information, presumed typical, was kindly supplied by the proprietor.

36. Paddy is purchased on the open market; much of it was seen to be notably dirty, muddy, due to sun-drying on an earth platform after threshing on the ground. Paddy cleaning in the mill was effective.

37. Cleaned paddy was shelled in a rubber roll machine, very effectively. However, the rolls had a life of 30 to 35 tons of paddy and then had to be sent to India for replacement of their 2cm thick synthetic wearing surfaces, at a total cost of about $200 per pair.

38. The brown rice was whitened and polished in an up-dated Engleberg type of huller-polisher, fitted with a powerful air-blast to keep it, and the rice, cool. Part A, para.89.

39. Rice emerged at two points - the whole grain (head) rice with 12-14 per cent brokens and wholly broken rice emerged at another point. The bran contained visible white rice powder and had a loose texture in comparison with pure brown bran. The breakage of rice was not less than 33 per cent, still a low figure for this type of machine.

40. Overall yield of whole and broken rice from paddy was reported as 65 to just over 70 per cent, and these figures were related to the quality of the rice, i.e. its dirt content and the degree of uniformity of the grains.

41. The bran was sold to a stock-feed blender on the Balaju Estate and the hulls from the rubber roll machine were sold locally as fuel for brick-making.

42. The rice was sold in two qualities: all brokens, and head rice with some brokens, in 100kg sacks.

43. The main complaints of the proprietor were the high consumption, about 20kw of power, its high cost per kwh; and the local price of replacement huller rollers, which alone added about $5 to his costs per ton of rice.

44. The mill is sited on quite a steep hillside and such sites are likely to be common in the central valley of Nepal where flat low ground is used for paddy growing.

45. A comment is that these mills should be designed on two floors to make use of gravity feed from cleaner, to sheller, to whitener-polisher. This would eliminate the need for power-driven vertical bucket conveyors which have no intrinsic merits.

RICE AS A PRIME EXPORT

46. Nepal is fortunate in that it can grow large quantities of wheat and maize in the central valley, and barley is grown in the hills and millet in the dry west end of the central valley.

47. It is the Government policy to encourage the production of wheat particularly, as a relatively cheap substitute for rice which is almost universally the favourite cereal. Rice always has an excellent export market in Africa, as well as in Asia. Wheat grows well in the dry west of Nepal, while maize does better in the moister and wetter east.

48. Quality is an important factor in exports of rice: low breakages, cleanliness and evenness of grain size. Better processing of paddy and the resultant higher production of white rice lead to possibilities of increasing exports of rice by some hundreds of thousand tons a year, to pay for badly needed imports.

PROCESSING OF WHEAT, MAIZE, etc.

49. These cereals are stone-milled in the traditional manner. There is a scheme to build and install water-mills to drive the flour mills, using streams in the mountain valleys. No problems similar to those of processing paddy seem to exist. However, drying and storage of all these grains is a problem yet to be solved and large numbers of small driers and vermin-proof bins or silos, each to hold a few tons for local reserves of food and seed.

MEAT

50. The cash incomes of the rural population are far too low to enable meat to be an important factor in the diet. Cattle, buffaloes - both working types, are to be seen, and also a few pigs.

51. There is little grazing land to support meat producing animals and poultry is of poor quality. The best hope for animal proteins for human diet seems to be to extract the bran from the paddy. With paddy production rising to 3mn tons a year, modern milling would save most of the bran now wasted and increase its availability, for well-bred poultry, to a quarter-million tons of concentrate a year.

PART B/2 - MALAYSIA

SUB-REGIONAL PAPER

PADDY AND RICE

Paddy is the main cereal crop grown in Peninsular Malaysia and in Sabah and Sarawak, total production being over 2.2mn tons a year and on a rising trend. Thousands of ha are being intensively developed north of Kuala Lumpur with irrigation and drainage: the Muda River and Selangor Schemes. Each area will be served by many large paddy mills, multi-stage types.

2. The present annual area cropped to paddy is over 0.8mn ha. The contributions to the national paddy production by Sabah and Sarawak total about 12 per cent.

3. The Malaysian population is about 12.5mn of whom 10.5mn live in Peninsular Malaysia, and 2.0mn, 16 per cent in Sabah and Malaysia.

4. The country is about 80 per cent self-sufficient in rice and has been importing variable amounts, 0.1 to 0.2mn tons a year, of rice from Thailand, Burma and China.

5. Annual rice consumption has been estimated at 1.5mn tons a year for a population of 12.5mn, giving a per capita consumption of 120kg a year.

6. Paddy cultivation is incidental to the big export crops of rubber and palm oil.

OFFICES VISITED IN KUALA LUMPUR

7. UNDP/UNIDO
Federal Industrial Development Authority (FIDA)
British Embassy
Indonesian Embassy
Pertanian (Agricultural) Bank
National Paddy and Rice Authority (NP&RA)

PADDY MILLING

8. The Pertamian Bank lends money for the purchaee of milling machinery but only provided that the NP&RA hae tested and approved the type in advance. Thsre is an NP&RA Rice Machinery Testing Station situated at the Muda River project.

9. The Englsberg single-etage huller-polisher is still widely used but it is on its way out. Ite yield of whols and broken rice from raw paddy (not parboiled) is not above 50 per cent. The centrifugal ("flash") huller is also used to a small extent. It ie cheap but it cauees exceptionally high breakages of the rice grains, worse than the Engleberg.

10. In the opinion of NP&RA, yield of white rice from paddy should be over 70 per cent in Malaysian conditions, and all the bran should be recovered as well. Current practice is to replace the Engleberg with a rubber roll sheller, and with the air-jet cooled polieher, which ie a much modified Engleberg. Breakage of graine with thie multi-stage mill is upwards of 30 per cent, but destruction of graine ie low and the bran is recovered.

11. When purchasing big multi-stage mille for ths large new paddy-growing areas, the NP&RA policy is to choose the beet available machine or equipment for each stage of the process. The main contractor hae to design his mill around these selected units.

12. NP&RA wae not aware of any baeically new deeigne for suitable milling equipment from the countries which traditionally manufacture it. The needs were obvious, particularly for paddy co-operativee and for small village millsre. Thailand banned the manufacture of the Engleberg ten years ago but it is etill widely used there also.

13. The overall official yields of white rice from paddy are published as 65, 63 and 63 per cent for Peninsular Malaysia, Sabah and Sarawak, while the multi-stage mills give a yield of 65 to 68 per cent, including broken rice. There ie not enough data for a calculation of the losses of rice in milling, particularly with Englebergs.

14. The problems of transport of paddy to the new mills of 5 to 6 tons paddy per hour capacity are considerable. Thase mille work continuously when paddy is available and they are highly automated. Taking their effective capacity each at 120 tons paddy daily, and the average yield of paddy as 3 tons per ha, they can deal with 40 ha of crop daily. Some of the paddy-fields are several kilometres from their mill.

15. The paddy crops are grown by small farmers on the newly developed areas as well as on the older paddy-fields.

16. The NP&RA prices for paddy and rice per ton are about US$240 and US$430.

RICE STORAGE

17. NP&RA is building up national reserves of white rice, mainly imported against vagaries of the monsoon in the neighbouring countries which make up the 200,000 ton deficiency in Malaysian rice production.

18. With good hygiene and use of chemicals, it is hoped to keep the rice in edible condition for as long as eight months. The northern area of Peninsular Malaysia receives much less rain than the south, so much so that paddy cultivation must have irrigation all the year round.

19. There are economic advantages in storing rice, rather than paddy, when the average atmospheric humidity lies in the 65 to 70 per range, or less. One cubic metre of storage volume will hold about 0.8 tons of rice but only 0.6 tons of paddy.

20. The 0.6 tons of paddy yields 0.4 tons of rice, when well processed in a multi-stage mill. So a cubic metre of storage holds twice as much human food in the form of rice rather than as paddy.

21. The reserves are also ready for immediate issue in an emergency, unlike paddy reserves which need accessible mills.

22. When the average humidity is over 70 per cent, special equipment is essential for long-term, 18-24 months, storage of white rice.

RICE BRAN STABILISING

23. Rice bran starts to go rancid after a day in warm and humid climates. Large mills have bran stabilisers but when small single-stage mills are replaced by multi-stage ones, a potential market is at once created for small stabilisers to deal with bran from groups of adjacent mills.

24. If these mills have access to hull-fired paddy driers, it may prove possible to use these driers, out of the harvest and drying seasons, for dealing with the bran which is continually produced from paddy stocks being processed to white rice throughout the year.

25. For each 1,000 tons of wet paddy dried down to 13-14 per cent moisture by artificial driers, preferably hull-fired, about 80-90 tons of bran is available for heat stabilising.

26. This stabilising calls for a much higher temperature than that suitable for paddy drying, 100°C, instead of 40°C., but much less air is needed than for paddy drying.

27. Once heat-stabilised, bran can be accumulated and used for stock-feeding. There is a rising interest in extraction of bran oil and its later processing to a cooking oil, for cosmetics and for other purposes. The remaining bran meal, like soya meal, is still a valuable stock-feed concentrate.

MAIZE

28. Maize is a minor crop in Peninsular Malaysia, but the country as a whole imports about 120,000 tons of it a year from Thailand.

29. There was no information that its processing was subject to special difficulties and destruction which beset rice. It is probable that its main consumers are beef cattle.

MEAT

30. The per capita GNP in Malaysia is relatively high, about US$1,000, and most of it in cash because so much of the agricultural produce is in the form of crops for export and not mainly for subsistence.

31. Accordingly meat, as well as sea-fish, is widely eaten and thousands of cattle are imported from Australia to increase the breeding herds.

MECHANICAL ENGINEERING

32. Peninsular Malaysia has a well developed capacity for mechanical engineering capable of manufacturing any single item of paddy mill equipment or machinery in use today. It is unlikely to have available and idle capacity to supply the country with its requirements of Engleberg replacement machinery, hull-fired driers and bran stabilisers. Paras.110 and 111 of the linked Regional Report for Asia are relevant in this connection.

PART B/3

SUB-REGIONAL PAPER - ASIA: THAILAND

CEREALS AND MEAT IN THAILAND

CEREALS

Only two cereals are grown in significant quantities in Thailand:-

	Tons mn/an.
Rice (paddy reported, 15.0mn tons) estd.	8.8
Maize, reported ..	3.0
Total cereals ..	11.8

2. Production of maize has expanded tenfold in the past 16 years, so data on it is still likely to be rather unreliable. Most of the maize is exported.

3. In the absence of full data on the numbers and types of machinery used for milling paddy, only a very rough approximation can be attempted for the production of rice from paddy. It is known that parboiling is rarely used and then specially for some of the rice to be exported.

PADDY and RICE

4. Engleberg single-stage huller/polishers used to be widely manufactured in Thailand until 1967 when Government prohibited further manufacture. It is reported that they are still in use and can be found on the market.

5. Attempts to replace the Engleberg have only been moderately successful. Two machines built in Thailand have been tried out: the centrifugal (flash) husker which depends on impact to split off the paddy hulls; and the horizontal stone roller huller which is a rotating cylinder of synthetic stone inside a cast iron casing. Paddy is fed in between the stone and casing and is temporarily held by adjustable rubber pads against the stone, so removing the hulls.

6. For home use, the hand powered disc husker is sometimes used: wedges of hard wood in clay matrixes, packed in two flat cylindrical baskets and dried. The upper basket is given a rotary motion by a long-angled lever, so the milling action is similar to that of pairs of solid horizontal millstones.

7. Multi-stage commercial mills, which are very numerous, are said to mill half the paddy crop, 7.5mn tons out of 15mn tons, a year. If these mills average 3,000 tons a year of paddy each, there must be 2,500 of them. This is a high proportion of multi-stage milling in Asia.

8. The I.U.Fo.S.T. Rice Report, 1976, contains a Thai paper on commercial milling which reports a yield of whole and broken rice of 66-67 per cent - well over one-third of the grains being broken on average.

9. 80 mills were selected as typical samples and described as Medium and Large Size; each size reported on separately.

10. The remaining 7.5mn tons of the paddy crop are therefore processed in Englebergs, centrifugal huskers, horizontal stone rollers, clay disc huskers, and by pounding. Had any or all of the last three mechanical processes been much better than the Engleberg, this type would have disappeared, their manufacture having been prohibited in 1967.

11. The estimate of white rice output from 15mn tons of paddy is therefore:

	White Rice mn. tons
7.5mn tons yielding 66.5%	5.0
7.5mn " " 50%	3.8
Total white rice produced	8.8

12. The Population in 1976-77, corresponding to these cereal figures, is estimated at 45mn. The per capita supply of white rice was accordingly 195-kg.

13. The ability of Thailand to export over 1mn tons of milled rice after a year in which the monsoon is neither seriously deficient nor excessive, is most fortunate for most South and South East Asian countries.

14. After normal exports, enough rice remains for the highly satisfactory amount of 173-kg. per capita annual supply.

Expanding the output of milled rice

15. The Thai paddy crop of a typical 15mn tons a year is grown on 8.5mn cropped acres, to give a low production of under 1.8 tons per ha. There are about 3mn paddy farming families, which allows of an average of 2.8 ha per farm family. Of the total population of 45mn, 75 per cent, or 34 million, work on the land but other important agricultural products including cassava (6mn tons of roots), maize (3mn tons), rubber, ground nuts, soya beans, sugar cane, all mainly for export, processed as necessary.

16. In this fortunate situation, there is not the rural under-employment endemic at a high rate in some paddy growing countries. The paddy farmers have largely replaced animal power by small tractors for preparing their fields for transplanting seedlings, and mechanical transplanting of seedlings has been used to some extent.

17. At harvest, the labour shortage is acute, and it appears that much wet grain paddy is lost by shedding, due to delays in harvesting. An effective and quick grain-saving harvester for small wet fields is not yet on the market. Much harvesting has to be carried out in flooded fields due to difficulties in organising drainage without proper single-purpose drainage channels which would take up productive areas.

18. The Thai paddy farmer, with his relatively large holding of fields, tends to use the minimum of inputs and has ample surplus paddy for sale anyway, after retaining about half his production to feed his family.

19. The present situation is unlikely to change rapidly so the priority is to obtain more white rice quickly from the low intensity of cropping by improved milling yields. The current average yield, estimated in para.11, is 59 per cent, a relatively high figure due to only half, instead of around 90 per cent, of the paddy crop being single-stage milled or hand-pounded.

20. With the modern paddy decorticating machinery (Part A, para.110), the country-wise yield can gradually be raised to 70 per cent, producing 10.5mn tons of rice instead of 8.8mn tons. In view of the ample supplies for the home population at present, this extra 1.7mn tons of rice is enough for almost 10mn people at the current high annual rate of rice consumption of 173-kg. each.

21. A continuation of the present 3.5 per cent rate of increase of population on 45mn for six years, would give a population of 55mn capable of eating the whole properly milled rice production of 10.5mn tons at 173-kg. a year each.

22. The need to start improving the paddy yield per ha of field is therefore imperative even if the rate of population growth falls, as it has done in Korea and Malaysia, to well under 2 per cent.

23. Second crop paddy amounts to about 7 per cent of the total. It is harvested in the middle of the monsoon, July - August period, with the usual difficulty of drying to a safe level of moisture for storage.

Paddy drying

24. Neither the small village "custom" mills nor the multi-stage "commercial" mills are normally equipped with artificial driers so losses in second crop harvested paddy are high. The commercial mills, which handle half the total crop, and most of the second crop, should equip themselves with paddy hull-fired driers.

25. Driers capable of drying, in three passes, 25 per cent moisture paddy an hour to 4 tons of dry paddy, are expensive. They have to evaporate 147-kg. of moisture at about 50-kg. per pass, to bring 1,150-kg. of wet paddy to 1,000-kg. of 14 per cent moisture paddy. In terms of burning white oil, about 20-kg. will be needed per ton of dry paddy.

26. In terms of heating fuel, one-fiftieth (0.02) of a ton of white oil saves paddy from which, at best, 0.7 tons of white rice can be extracted plus bran worth another 0.03 tons of rice. The oil needed per ton of white rice equivalent is therefore 20 (1 ÷ 0.73), 27-kg. Depending on logistical expenses and taxation, the cost of white rice and white oil per ton are not far apart, roundly $300. But a ton of heating oil can save 37 tons of food and feed for the nation.

27. While white oil has a calorific value of 10,000 to 11,000-kg. calories per kg, dry paddy hulls have a value of 3,000-kg/cal/kg. Pro rata on this basis, about 100-kg. of hulls will be needed to dry 25 per cent moisture paddy down to 1 ton of 14 per cent moisture paddy. Shelling or hulling of dry paddy produces 200-kg. of hulls available for fuel and this potential is merely an environmental nuisance at present.

28. In very approximate figures, a paddy drier, preferably hull-burning, producing 4 tons an hour of well-dried paddy from wet paddy of 25 per cent moisture, otherwise going to waste, would repay its capital cost to the nation with the first 150 tons of dry weight paddy saved.

29. The commercial miller can only recoup his capital expenditure by purchasing wet paddy at a particularly low rate from farmers who would otherwise lose their crop entirely. Even he might recoup his capital with the first 600 tons dried, which is only 150 operational hours.

30. Drier running coete, with free heating fuel, are low, in relation to 4 tons output of dried paddy per hour, worth about ฿800. A large fan to force the warmed air through the grain will abeorb about 6-kw., at an hourly cost of say ฿0.60 for electricity.

31. Apart from eaving wet season crop otherwise loet by rotting, the ability is useful to dry, or re-dry, properly the sun-dried paddy bought to be used for building up mill stocks for off-seaeon milling.

32. Milled rice stocke which have been held too long, and so have picked up some moisture, can aleo be quickly and cheaply dried down to a safe level for further storage.

MECHANICAL ENGINEERING INDUSTRIES

33. Almost all the rice milling machinery used in Thailand is, or could be, manufactured there. Power tillers of simple design are also made at a rate of several thousand a month, to replace buffaloes and cattle in soil preparation.

34. Paddy driers do not yet seem to be euccessful perhaps becauee deeigns suited to local needs are not yet available in Thailand.

MAIZE

35. The 3mn tons of maize now being grown a year is mainly exported or ueed locally for etock-feeding. One recent study shows that the agricultural or rural population eat a negligible amount of it, while in Bangkok, population about 4mn., the proportion of rice to maize eaten is about 13 to 1. Wet and dry milling technologies for maize have long been established and at high levels of recovery of food and stock-feed. Proceseing of maize to starch, and to the numerous by-products, may become necessary in Thailand.

WHEAT

36. About 20,000 tons of wheat a year is imported from Australia, but this amounts to only 0.26 per cent of the consumption of white rice.

FOOD MANUFACTURING

37. A large number of small food manufacturing industries exist in Bangkok. Kasetsart University has carried out a great deal of research on proper formulation of infant foods, soya based milk, high protein composite meal, and snack biscuits. Over 100 graduates are reported as being employed on such work.

38. The most up-to-date statistics, 1977, give 7,400 persons on record as employed in food (not beverage) industries in Bangkok in 1970, and 4,500 in 1971.

39. The main objects are to improve the nutrition of the low-income section of urban populations, utilising local and inexpensive materials with high protein contents such as mung and soya beans. The packaging of these products is notably effective and suitable for display in shops and super-markets.

40. A study by a Professor of the same University in 1977 shows that the rural population has a higher caloric diet than that of Bangkok; and, as regards vitamins, it only lacks B2 to a notable extent, while Bangkok diet is short on several vitamins.

41. A factor that cannot readily appear in protein statistics, in which the rural population is recorded as having slightly less protein in its diet than Bangkok citizens, is the large amount of fish and shrimps caught by paddy farmers and others in ponds, rivers, irrigation channels, in their own flooded fields and in the sea.

42. An interesting sideline is on concentrating young coconut flesh and milk to a thick soluble paste, well packaged. The paste, added to water, is an effective substitute for fresh coconut milk in which rice is traditionally cooked in rural areas and also by urban people who can afford to buy green coconuts.

MEAT PROCESSING

43. Meat, red and white, is far less important than fish as a source of protein, and one estimate gives the proportion of meat to fish eaten as one to nine.

44. A 1977 report gives some data on meat processing: 80 tons a day canned in one plant, primarily for the Ministry of Defence, and five small companies can meat and also fish.

CONCLUSION

45. The paddy milling industry with its 2,500 large and medium-sized commercial multi-stage mills and over 25,000 single-stage "custom" mills together employ perhaps 150,000 people inside the mill compounds, plus many thousands on manufacturing machinery and equipment for the industry, and on river, road and rail transport of paddy and milled rice. All other processing of cereal food is relatively marginal to the economy and GNP of the country.

46. There is scope for increasing the production of paddy by more double-cropping in areas where the monsoon is long and intense employing modern cultivation methods, based on IRRI research, in which HYV seed, fertilisers and protective chemicals are direct-drilled. This is instead of using transplants and subsequent surface and aerial applications of the other inputs. By AD2000, the labour input per cropped ha can be reduced by 90 per cent, using methods and inputs already established and simple cheap equipment in an advanced stage of development.

47. Modern milling equipment, usable even in remote rural areas, can increase rice yields from paddy by 40 per cent from single-stage mills and by 5 per cent from existing multi-stage mills, with a very small proportion of broken grains.

PART B/4 - INDONESIA

SUB-REGIONAL PAPER

CEREALS

PADDY AND RICE

Paddy

Paddy is the dominant cereal crop throughout the arable areas in the numerous Indonesian islands. About 8.8mn ha are intensively cropped annually. Total paddy yield is about 23mn tons, 2.6 tons per ha, with a rising trend from the traditional 2 tons per ha.

2. Great efforts have been made to popularise the high yield variety (HYV) seeds, bred from IRRI and local varieties and multiplied up for issue to farmers, all under the Government's auspices. Irrigation has been extended and run-down old irrigated areas have been reconstructed. In some of these irrigated areas five crops of paddy are being grown in two years, using a high proportion of HYV seeds. Urea and TSP fertilisers are manufactured in Sumatra and Java.

Rice

3. The official FAO figure of yield of white rice from paddy is 60 per cent but this is widely recognised by Indonesian field agronomists and others as being too high. A 1973 study showed that over 50,000 Engleberg single-stage hullers were in use and about 800 multi-stage mills of 1 to 2 tons an hour capacity.

4. Field studies then gave the usual rice yield of 50 per cent on paddy for the Englebergs and about 67 per cent for multi-stage mills, with home pounding at an indefinite and probably widely variable figure. The overall yield was then estimated at 51 per cent white rice on paddy. It must be a little higher now, with a production of rice of 12-13mn tons a year, enough to supply about 100kgs. a year per capita of the 132mn population.

5. Great efforts have also been made in setting up rice co-operatives: the BUUD project; one co-operative for 800 to 1,000 ha of paddy, with six to ten typical farm villages per co-operative. The co-operative offers all the usual services: banking, marketing of surplus paddy and rice, supplies of inputs for the paddy crop and extension services to advise farmers on use of irrigation, drainage and the HYV seeds.

6. The co-operatives are each to have an up-to-date integrated paddy mill. It will be able to accept unthreshed, freshly harvested wet paddy on the stalk, straight from the surrounding fields, for power-threshing, drying the grain in a continuous hull-fired paddy drier, cleaning and storing it until required for milling to white rice and bran, with the clean hulls collected for drier fuel.

7. A farmer whose paddy grains shed easily in the field will have the use of small portable threshers to reduce the field and transport losses. He will also be able to bring his threshed and sun-dried paddy to the mill for cleaning, storage and milling. Distances from field to mill should mostly be under 1.5 ha, along earth tracks, in general.

8. BULOG is the Authority responsible directly to the President of Indonesia for rice and other key food supplies, certain other necessities, and also for overseas procurement.

9. BULOG staff are acutely aware of the breakage and losses of rice that occur even in the best milling machinery available to them. The co-operative mills are being equipped with rubber roll shellers, despite their high cost for replacement rolls, and with whitener-polishers which break 30 per cent and upwards of the rice grains and blow pulverised rice into the bran.

10. Nevertheless, this combination, probably the best available, is a major improvement on the widely used Engleberg mill because the combination's yield of rice from the paddy crop is a third higher than from the Engleberg, the bran is recovered and hulls will be available for fuel when suitable paddy driers become available.

11. One large continuous paddy drier, hull-fired, is under trial by BULOG in its machinery testing station at Tambun, near Jakarta. If successful, the plan is to part-manufacture and assemble these driers and their furnaces, using some imported components, in a large Government-owned factory in Java. Some threshers are also under trial, with the possibility of part-manufacture and assembly.

Storage of Paddy and Rice

12. BULOG is responsible for procurement from indigenous and overseas sources. Indigenous procurement can be in the form of either rice for early sale to the local markets or paddy for reserve storage. Imports are in the form of bagged milled rice, and the rate of imports was recently 1.9mn tons a year, which makes Indonesia the biggest rice importer in the world. Rice is being bought mainly from the USA, Burma, Thailand and Australia.

13. BULOG has built hundreds of large steel sheds at suitable points, with a total capacity of well over a million tons of paddy and rice.

14. One shed has been adapted for receiving wet paddy and drying it in bulk and in situ, as a full-scale experiment. A very large fan is driven by a diesel engine to force air systematically through batches of paddy in turn. The fan air picks up the waste heat of the engine to reduce the humidity of the air. The engine is operated during the hours when ambient humidity is at its lowest level, around midday. Oil-fired heating is available too.

15. It is well known that a given volume of storage will hold twice the weight of rice as it will of rice still in the form of paddy. The paddy hulls are bulky.

16. Air humidity in Java, where most of the Indonesian population live, is relatively seldom down to 65 per cent or less. At these levels, cereals - including paddy and rice - in store reach a moisture content of 13 per cent, low enough for long-term, 18-24 months, storage, subject to control of pests.

17. Emergency reserves safely held as rice, not as paddy, have the advantage of being ready for immediate issue; whereas paddy naturally has first to be sent to mills which may not be operable due to some emergency, e.g. floods.

18. When the average humidity is well over 70 per cent, as in most of Indonesia, long-term reserves of milled rice can only be accumulated by using special equipment for the storage space. Economy in storage space has to be offset against the cost of special equipment.

The BUUD - BULOG Co-operative Concept

19. This rice co-operative concept is an excellent one which could be copied elsewhere with advantage. Each modern co-operative mill, of the thousands planned, can become a nucleus of rural industry.

20. The scope for further improvement of paddy yields is still substantial, say from 2.6 to 4.0 tons per ha per crop. Even without irrigation, double cropping can replace single cropping over large areas, with monsoon rain and use of the IRRI technique of two crops; one starting drilling at the onset of the monsoon, harvested mid-monsoon; immediate replanting for harvesting in dry weather a month or more after the end of the monsoon. Both crops have to be of early maturing varieties.

21. With efficient milling equipment, losses of rice can be reduced heavily and grain breakages almost eliminated. Farm cash incomes rise several hundred per cent, all to be spent, mostly locally, on goods and services to be supplied initially by the urban populations, and then by a build-up of businesses around the co-operative mills.

22. The small farmers retain their land, under the law, and receive equal treatment in the supply of inputs and sales of paddy with the big farmers in the co-operatives.

23. The BUUD concept is aimed at helping the farmers in rural areas to raise their cash incomes from paddy so that they become much bigger markets for urban and local goods and services. In doing so, the farmers would free the Indonesian economy from the burden of purchasing millions of tons of rice from the declining surpluses available in other countries.

24. Linked to the BUUD concept is a plan to establish a Government manufacturing industry to build paddy and rice machinery which will have as low processing losses of food and stock-feed as those normal in wet-milling of maize and milling of wheat.

25. Indonesia is still the largest country at risk of a serious food shortage in South and South-East Asia, despite the enormous efforts of its Government to grow more paddy.

26. The paddy is available, thanks to the HYV seeds, fertilisers and chemicals, and some irrigation, 23mn tons a year. With efficiency of milling comparable to the machinery used for other cereals, the yield of rice, at 72 per cent on paddy, would be 4mn tons higher, at least; enough to increase the amount of indigenous white rice per capita by 30 per cent from a total production of rice of about 16.5mn tons.

27. The cost of a co-operative paddy decorticating mill for an output of 575 tons of rice a year replacing the Engleberg's 400 tons, from 800 tons of paddy, should not exceed $7,000 or $8,000.

MAIZE

28. About 3mn tons of maize are reported as grown a year on about 3mn ha. In general, it is not grown intensively like paddy, but to make use of vacant drained soil, as between coco-nut palms. The spacing is wide, each stalk having a square metre to itself and it suffers from the shade cover effect of the palms. The yield of one ton per ha ie one-tenth of the optimum, but the optimum is only achieved in open fields, with hybrid seeds and large inputs of fertilisers and chemicals.

29. Maize can be regarded in Indonesia as a minor crop for village consumption to fill the gap in diet calories due to insufficient rice. It is in the same category as of the root and tuber crops grown around farm-houses, subsistence crops.

30. Processing is generally by hand, or using hand tools.

WHEAT

31. Though no wheat is grown in Indonesia, the Government has encouraged the setting up of exceptionally large modern wheat mills at the ports of Jakarta and Surabaya in Java. Their joint capacity is 3,800 tons of flour a day, on continuous operation; over 1mn tons a year. It is mainly for urban consumption as bread. Most of the wheat comes from Australia and the USA.

32. This amount of flour has to be seen in relation to the total of indigenous and imported white rice, about 15mn tons now consumed in Indonesia annually plus about 3mn tons of maize. Wheat-flour consumed is about 5 per cent of the total of the three cereals - milled rice, maize and wheat-flour - but the percentage is likely to rise unless rice production catches up with the country's requirements.

MEAT

33. Red meat is a minor or negligible item of diet and outside the bigger urban centres; only pork is common and that only in the Christian villages. Working cattle are exported on the hoof to Hong Kong and Singapore to compete with high quality Australian meat.

34. White meat, poultry and the eggs, are produced in most farmsteads, but grain is lacking for feeding them for quick maturity and high egg outputs. Most of the bran available in Indonesia's 23mn tons of paddy is lost in pounding and milling, except in the growing number of multi-stage mills in the rice co-operatives.

35. A typical co-operative mill dealing with paddy from 800 ha of fields, with 30 per cent double cropping will process 3,000 tons a year from say 1,000 farmers. The bran, 250-300 tons shared among the farmers, will provide nearly one kg of high protein, high fat, concentrate daily to each farm family; enough to maintain a small flock of free-range poultry in lay.

36. With further intensity of paddy cropping and higher yields, there will be enough bran for a poultry co-operative to be added to the rice mill, fully equipped to process, pack and deep-freeze poultry for sale in urban areas.

37. About 2mn tons of rice bran is currently being lost a year due to inefficient milling machinery and pounding, enough to give vital help to producing half-a-million tons of poultry a year, or equivalent eggs.

38. Fish, from both fresh and salt water, are extensively eaten in Indonesia, and sea-fish is sun-dried to preserve it long enough for transport to inland villages.

PART C - SUMMARY
WITH AGRICULTURE AS AN INTEGRATED INDUSTRY.

INTRODUCTION

Twenty-three Ministers of Industry, mostly from the Asia and Pacific Region countries, attended the ESCAP Conference held in Bangkok from November 28th to 30th, 1977. Representatives from seven international organisations were also present:

UNCTAD, UNDP, UNEP, UNIDO, ILO, FAO and UNESCO.

2. The report on the meeting, published on January 3rd, 1978, - E/ESCAP/59, indicates the strongly held views of the Ministers that much more help than in the past should be given to the rural economies, as the following brief extracts demonstrate:

Para. 4 "By the creation of indigenous manufacturing capabilities", ---

Para. 8 "Industry had a very weak nexus with what should be its real objective, namely, the raising of the consumption standards of the vast masses of the poor."

Para.13 "--- large-scale industries ----- could also provide support to small-scale industries and offer special services and supplies to the agricultural sector."

Para.33 "The political aspects of such a re-orientation involved a transformation of existing urban-oriented socio-economic power structures."

Para.35 "--- one of the most important issues was the strengthening of the linkages between industry and other sectors of the economy, in particular, industry's linkages with agriculture:" and para.37 "--- the impact it would have on the life of the rural community."

Para.38 "The dispersal of industries away from metropolitan areas constituted an important aspect in strengthening the links between industry and agriculture."

Para.40 "The establishment of such (i.e. small and medium) industries in rural areas would require greater state assistance and intervention."

Para.41 "The development of agro-industrial complexes was also relevant."

Para.42 "—— special attention should be paid to the development of technology suited to small- and medium-scale industries ——. It was difficult to expect that such labour-intensive technology could be found ready-made in the developed countries."

Para.45 "—— special consideration should be given to the least developed land-locked and developing island countries."

3. In an Annex to the report on the Ministers' Conference, para.24 reads:

"The meeting of Eminent Personages had recommended that agriculture should be given the status of an industry and that linkages should be established between small and basic industries."

4. This summary report treats the paddy growing and paddy milling and rice storage industries as integrated. This is because paddy, unlike wheat and other grains, is useless for food or feed until it has been processed to remove its totally inedible hull (husk).

AGRICULTURE AS AN INTEGRATED INDUSTRY

5. The most specific of the above quotations is believed to be - "that agriculture should be given the status of an industry".

6. Of these five reports on food processing in the Asia Region, the first covers the Region as a whole and the remaining four cover the specific cases of Nepal, Malaysia, Thailand and Indonesia - all visited in August 1978 during the course of this study. In previous years, visits had been paid to the five countries of the Indian sub-continent and to the Philippines and Indonesia.

7. The Asia Region countries produced about 400mn tons of wholly edible food or feed cereals in 1975, or in twelve months of 1975-76. Their population was about 2,200mn, giving an average of 182-kg. of cereal annually per capita.

8. They used about 16mn tons of white centrifugal sugar plus a large but unknown amount of village-made non-centrifugal brown sugar, virtually all from sugar cane; perhaps 8-kg. total annually per capita.

9. Cane sugar manufacture from estate-grown cane has long been treated as an integrated industry. So has the canning of vegetables; also of tropical fruits such as mangoes, guavas, pineapples and lichis in white sugar syrups: all luxury foods and mainly for export to developed countries.

10. Vegetable protein requirements are met by legume crops: pulses, peas, soya and mung beans mostly grown in small patches in areas where fish is neither cheap nor easy to catch.

11. Cooking oils are obtained from mustard, rape, sesame and other oil seeds and from ground-nuts and coconuts. Hardening of these oils by hydrogenation to cooking fats is a well-established industrial process for supplying urban markets.

12. Red and white meat, eggs and milk are unimportant and also very expensive foods for the vast majority of the populations - rural as well as urban, millions of whom are vegetarians anyway.

MECHANICAL ENGINEERING FOR CEREALS

Cereal cultivation

13. It is surprising that the most important of the agricultural industries in the Asia Region, paddy and rice, are also the worst served by mechanical engineers. Of the six leading cereal crops harvested in 1975, paddy at 319mn tons, is 57 per cent of the total of 555mn tons. It is also by far the most widespread: from Korea in the north to Indonesia in the south; from Pakistan in the west to the Philippines and Japan in the east.

14. The second largest Asia Region crop is wheat, 105mn tons, virtually all of it concentrated in the middle belt of China and just south of the Himalayas, in India and Pakistan. Maize, millet and sorghum, barley and oats are produced in much smaller quantities - 50, 46, 31 and 4mn tons a year.

15. For these five dry-soil crops, there is a wide range of mechanised equipment available for efficient cultivation, harvesting, milling and storage, at any required level of sophistication and capital cost.

16. Paddy of the Indica varieties and moetly grown in flooded eoils, ie now only adequately mechanieed when it can be drilled and harvested in large dry fields, with irrigation under full control for the growing period up to near the harveet; or, with a very reliable rainy period. Then, ordinary dry-soil cereal machinery is ueed.

Contrast between other agricultural disciplinee for paddy and mechanical engineering.

17. On examination, the contrast ie etartling between the dedicated and highly eucceesful work of the plant breedere, seed multipliers, agronomiete, chemists and civil engineere on the one hand, and the neglect by (and of) mechanical engineere. The first group of dieciplines work in full integration, within their own dieciplinee, on the requiremente of the high yield varietiee (HYV) of paddy up to the etage of readinees for harveeting.

18. The mechanical engineers have, in general, not helped the small farmer who growe nearly all Asia'e, and the world'e, paddy. Little effective work hae been done in eupplying euitable equipment for reducing the uniquely high labour inputs that hie traditional methods require or to help him with equipment to deal with the very epecial needs of HYV seede.

19. In effect, there hae been an iron curtain between the mechanical engineere and the other disciplines which are eo effectively involved in exploiting HYV seeds.

Projects for paddy cultivation

20. Thie is also clear in the numeroue international aid projeote for rice, which are limited to growing more paddy, but without recognising the need for mechanical equipment to grow the HYV seede, harvest, threeh and procese them efficiently to high yields of white rice.

Storage for milled rice

21. These projeote aleo omit the need for epecialieed mechanical equipment for long-term storage of white rice. There are constantly emergency periods occurring in paddy-growing countries which deetroy grain etocke and cauee crop failuree or loseee: too little or far too much moneoon rain, floode, insect invasions, typhoone and incursions of sea-water, are all common.

22. Paddy is relatively easy to store for a couple of yeare but without large milling capacity available and at hand, it is uselese ae food for people in an emergency period.

23. White rice picks up moisture rapidly in the humid tropics and starts to deteriorate once its moisture content exceeds 15 per cent. This may take four to eight months, not enough to bridge one annual harvest and the next. The storage problem can be solved.

PADDY AND RICE INDUSTRY TOO LABOUR-INTENSIVE

24. The paddy growing industry on very small fields, several or many to the hectare, is normal in Asia. It is far too labour-intensive to allow real improvement in the Asia Region rural economy. Normal methods require at least 1,000 man- or woman-hours per ha of crop. Weeding, needed particularly on upland (not flooded) areas, can double the labour input.

25. The output is likely to be two tons of paddy per ha of crop, from which one ton of rice is commonly extracted with machine milling. Accordingly, the field labour input is at least one hour per kg of white rice.

26. But if the paddy is hand-pounded to rice, traditionally by the women and girls, at least another 1,000 hours of work are needed per ton of white rice.

27. Fortunately, machine milling has taken over from hand-pounding, very extensively, and relieved many farm families of a heavy daily task taking two hours.

28. This reduction of labour input per ton of white rice by 50 per cent ie a major beneficial social change. Any further uses of equipment to reduce labour inputs can only have smaller impacts on rural society than that already achieved unobtrusively and without the harmful social revolution prophesied.

29. Hand-transplanting of paddy seedlings is another onerous task usually allotted to the females of the family. Each one ha crop requires about 200,000 bunches of paddy seedlings, weighing 5 tons, to be removed from the farm nursery and carried along the small embankments for accurately spaced traneplanting in the flooded fields.

30. These operations take about 250 hours per ha, a quarter of the usual field-work.

31. Mechanised traneplanting machines are in use in Japan and Thailand, but they still need the 5 tons per ha of seedlings to be brought to them and rather specially grown seedlings too, for the machinery to cope with.

LABOUR-SAVING AND CROP EXPANSION METHODS DEVELOPED BY IRRI

32. Work by the International Rice Research Institute (IRRI) in the Philippines, has shown that two heavy crops of unirrigated paddy can be grown from direct drilled seeds in one monsoon period. All seeds are of early maturing varieties and the first harvest, in mid-monsoon, is from seeds drilled when the first rains of the monsoon have softened the soil.

33. There is still time for a second crop to make use of the rest of the monsoon rains and its harvesting takes place in the dry season. Suitable areas for double-cropping on monsoon rains cover about 33-35mn ha of the Asia Region.

34. This IRRI method reduces the labour input by direct drilling instead of transplanting the early crop and obtaining two crops with one preparation of the soil. It uses weed and insect control chemicals as well as fertilisers, all more than paid for by each heavy crop.

EQUIPMENT AND TARGETS FOR PADDY CULTIVATION

35. While current methods of growing paddy on small farms require 1,000 hours and upwards for a 2 ton per ha crop yielding one ton of rice, fully mechanised wheat requires 10 hours for a 5 ton per ha crop. This is a contrast of extremes: 500 hours per ton of white rice and two hours per ton of wheat. Rice costs twice as much as wheat per ton.

36. A reasonable target for AD.2000 would be to reduce the labour input per ton of paddy by 90 per cent, from 500 to 50 hours per ton, on small fields. This is still extremely labour-intensive by the best performances on wheat cropping. It could be achieved by two means working in parallel: labour-saving equipment and doubling the yield of paddy with the use of labour-saving equipment.

37. In designing the suitably simple and inexpensive labour-saving equipment, the approach is not to use or adapt equipment for crops grown on dry soils. This would be repeating the mistake already made in the machinery now employed for processing paddy to rice - use grain pulverising machinery for decortication processes.

38. The designs of equipment for heavy crops of HYV paddy by small farmers on tiny wet fields have to take the well-established and very special requirements of HYV seeds into account. These include water use, soil conditions for the seed, efficient use of fertilisers and protective chemicals, weed control, and the ability to harvest the paddy quickly even when

the crop is still standing in mud and water.

39. All this design work and turning designs into successful hardware for field use, is in the neglected discipline of the mechanical engineer. The failure of ths "green revolution" in paddy and its succees in wheat and maize ie the failure of the mechanical engineer to deal with a wet crop and his success with dry crops. The wet crop problems can be solved.

MACHINERY AND TARGETS FOR PROCESSING PADDY TO RICE

40. Most of the rice milling industry in South and South-East Aeia, where the "long" and "short" Indica varieties are normally grown, is the most inefficient and backward of the world's major mechanical induetries.

41. No other induetry wastes so much power in destroying so much of its prims products; in degrading them; and in consigning them to the rubbish-heap.

42. Ths machinery used in rice mills doee not appear to have been deeigned initially for paddy at all. The Engleberg coffee-grinder with its derivatives, and the variatione on ths very much older stone flour mills, have been pressed into service to fill gaps that should have long been filled by mechanical engineers.

43. Even the widely used rubbsr roll paddy huller (sheller), which destroys its own rubber milling surface rather than the rice grains, is reputed to have been designed for a totally different purpose.

44. The Engleberg (Kiskesan) in its normal role as a single-stage Indica paddy huller-polisher, mills far more Indica paddy than all the other mills in the Asia Region, excluding perhaps China, about which there is insuffic-ient information. There are an estimated 250,000 Englebergs in the Region, including over 100,000 in India, 50,000 in Indonesia, 10,000 in the Philipp-ines, and 1,800 in Nepal.

45. The economics of the Engleberg are exceptionally unfavourable. Its optimum yield, all of it white rice with half the grains broken but edible, ie 500-kg. from 1,000-kg. of raw (not parboiled) paddy. The remaining 500-kg. is useless for any purpose and is dumped; a mixture of high-silica hull fibres, bran and pulverised rice.

46. Rice experts agree that it should be possible to extract 720-kg. of white rice from 1,000-kg. of clean raw Indica HYV paddy; also to recover 60 - 80-kg. of pure brown bran for stock-feed, and all the hulls, 200-kg., for fuel.

47. The Engleberg pulverises and so renders useless 220-kg. of white rice for each ton of raw paddy fed into it. With rice at $300 per ton, the potential value of this destroyed rice is $66. The other products lost can be valued at $10 per ton of paddy milled: total $76.

48. If the Engleberg, without engine, counter-shaft, pulleys and belts, can be bought for $2,000, it destroys rice, bran and hulls of a value equal to its capital cost for each 2,000 ÷ 76, i.e. 26 tons of paddy that it mills. It may mill 400 tons a year and it has a long life.

49. In replacing this machine, it is not necessarily a cheaper one but a non-destructive one that is required.

50. Any huller and polisher unit which is small, simple and rugged enough for use by a village miller or rice co-operative will quickly pay for itself if it can increase the yield from each ton of paddy by $76 above the Engleberg performance.

51. These Engleberg replacements should be constructed in the user countries, incorporating imported components as necessary.

52. The number of "large" mills, multi-stage and with capacities of 1 to 5 tons paddy per hour, with few exceptions, are unlikely to number as many as 10,000. India is building them by private enterprise to replace Englebergs, and Thailand with 2,500 probably has more than any Indica growing country, excepting China. These mills are already very efficient by Engleberg standards though there is still room for improvements. Their priority for replacement machinery is far below that of the Englebergs.

53. A reasonable target for Engleberg replacements is to build 10,000 a year of ½-ton an hour low-destruction units, to replace 25,000 Englebergs; a ten year programme.

54. Such a programme would quickly become self-financing on a national basis, either by increasing exports or reducing imports of white rice. Each new machine would repay its capital cost several times a year in terms of increased value of production.

55. The problems of design, manufacture, operation and maintenance can be solved by good mechanical engineering.

RICE CO-OPERATIVES AS NUCLEI FOR RURAL DEVELOPMENT

56. The extract quoted in para.3 above is - "that agriculture should be given the status of an industry —— ".

57. The Indonesian Government's BUUD - BULOG rice co-operatives will meet this and the other objectives quoted from the ESCAP Report E/ESCAP/59 of 3rd January 1978.

58. Each of these co-operatives, averaging about 800 ha of paddy-fields, is becoming an integrated agro-industry supported by a Government factory to manufacture equipment and machinery for the fields, for paddy processing to rice and for grain storage.

59. Current paddy production of about 2,000 tons a year can be doubled by some degree of second cropping plus higher yields of paddy per ha with equipment for using HYV seeds effectively.

60. The value of yields from the processing of paddy can be increased from Engleberg levels. With paddy output rising from 2,000 to 4,000 tons a year, white rice at $300 a ton and bran at $100, the initial and developed values of co-operative output are:

	$
Initial	
2,000 tons paddy yielding 1,000 tons of rice ...	300,000
Developed	
4,000 tons of paddy yielding 2,800 tons of rice	840,000
280 tons of bran	28,000
	$868,000

61. The typical population of the co-operative area is likely to be 5,000 persons who would eat 700 tons of the rice. The sales income would initially be from 300 tons of rice sold for $90,000. The developed co-operative would have an income from 2,100 tons of rice - $630,000, plus $28,000 from bran: total $658,000, a 600 per cent increase of cash income, to be spent on goods and services or productively invested.

62. Major benefactors are, in fact, the urban population, outnumbered by nearly three to one by the rural population with so much more money to spend.

63. The cash flow stimulates urban industries and services, and provides capital for setting up small rural industries, particularly poultry farming to make use of the bran now available.

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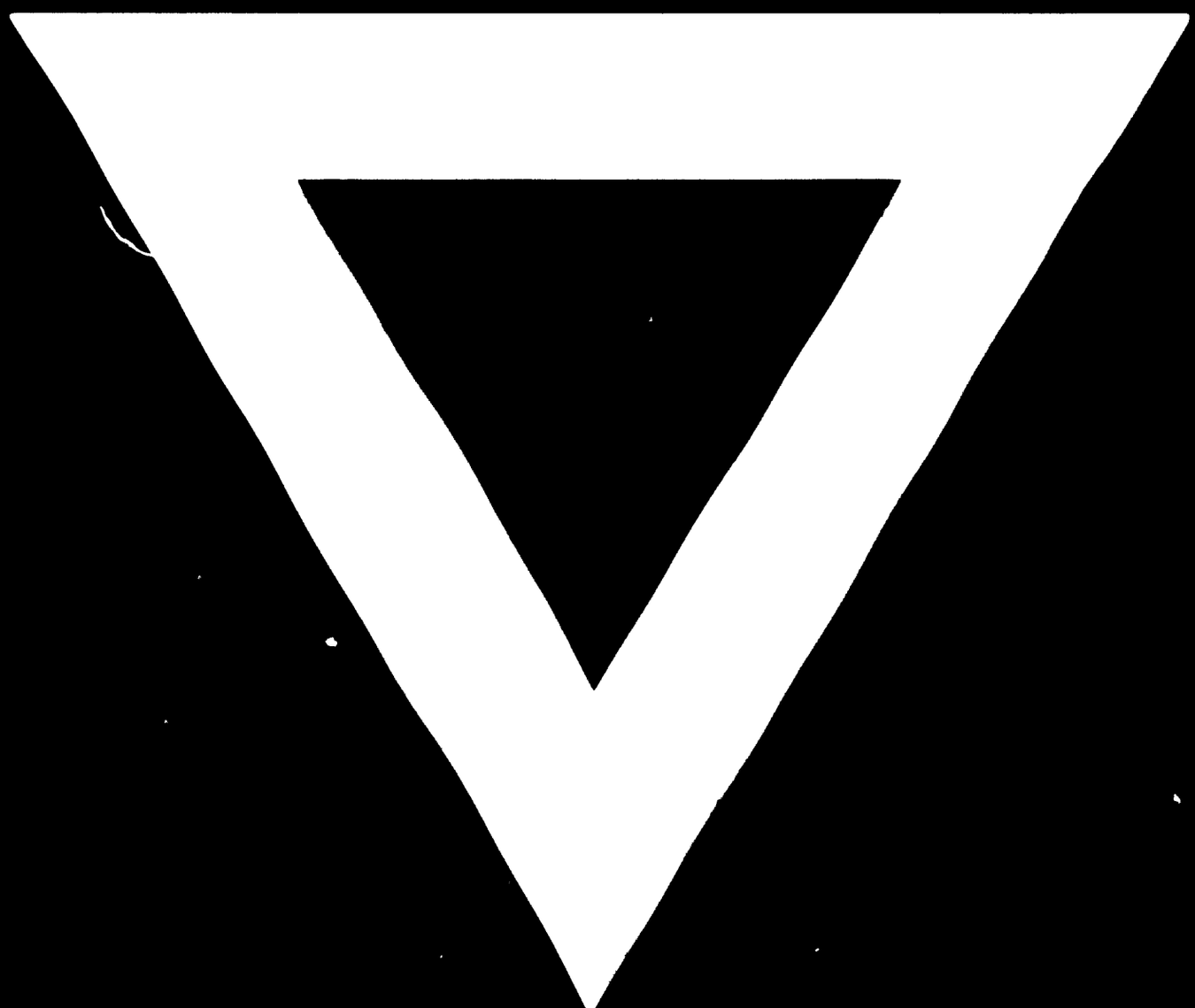

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