APPENDIX 4
"DEMAND ANALYSIS"

Estimated worldwide vegetable consumption
c. planned
develop1n3 countries
countrles
developed countries
:ype of
vegetable
1. zamaco 34 11.6 85 14.3 9 11 41 12
2. peppers 3 1.0 90 1.3 6 7 6 2
l. egga1ant 2 0.7 90 0.8 2 2 7 15
4 fleshy ,
cucurb1ts .6 5.5 35 6.7 3 8 9 19
V mHG9’V50"Ls L2 u L6 3 s 19 4
me1on
6. heading
cabbage 19 6.5 85 8.0 2 6 12 7
7. cauliflower.
brocco11 14 4.8 85 5 9 0 1 4 1
5. leaf cabbage 3 1.0 80 1.3 1 1 2 4
9. onions and
1 . . 4 4 4
shallo:s(dry) S 5 l 90 6 3 2 1
10. green onions,
leek,bunch1n3 3 ’ 1.0 85 1.3 0 0 5 2
, onion
11. garlic 1 0.3 95 0.4 0 1 2 1
12’:$:M0W5 9 SJ 75 38 a 1 2 6
11 yen hum 3 1A as L3 2 1 2 2
14. green peas 9 3.1 85 3.8 1 1 . 5 1
15 dry beans(for q -
sp:ou:1ng) . 0 0.1 0 0 0 2
14. 1eczuce 15 5.1 85 6.3 1 1 3 1
17. green leaf
ve;.(exc1. 3. 20 6.3 75 8.4 31 5 11 15
10. 15)
13. :arro: 11 3.8 85 4.6 ’ 1 1 6 1
l9. :25:s.:ubers 7 2.4 75 2.9 2 2 4 2
(ex:1. 18)
EC. shoo:s,
sprou:s, 6 2.1 80 2.5 1 2 2 J
f1ouers,sta1ks
21 50:2: corn 11 3.8 80 0.1 0 0 0 0
22. okra 1 0.1 65 0.4 6 2 J a
23 Various seeds a
(ex:l’ 13.14, v 0 - 0 1 3 0 2 1
15)
24. Egshrooms 1 0.3 95 0.4 1 0 1 1
Y o : a 1 : 221 75.5 87 88.6 4 69 60 162 110
Source: Tropical Vegetables and their Genetic Resources,
G.J.H.Grubben,IBPGR,Rome 1977
P(Oduc’ 0’ 2 consumption g/caput/day
COHS- t1on6 sale productLon SUI Other
g/day x 10 t Z x 106 z 1 Africa America C.Asla areas
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mean x 106 c
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Yields of p-3duct,edible protein and edible energy from the
produce of 1 ha of livestock productions.
____-_____________._________
Produc! (kg) Edible Edible
prolein energy
Carcass1 Eggs Milk (kg) (MI)
W
Eggs 85 1250 ’ 138 8900
Broiler 12250 137 7 500
THMkcy 1000h . 144 4200
Rabbit 730 118 4800
Bacon ;
12 piglcls/year _ 745 1 . 80 7 700
24 piglels/ycar . 900 98 9300
Sheep
1-4 lambs/year 268 32 3500
2-8 lambs/year 423 - 50 5500
Suckler cow 1 .
0-9 calves/year 255 35 2800
1-8 calves/ycar 365 . 50 4 100
Milk with low concentratesc 60 3940 138 11 500
Milk and 18 m beef" 166 2 800 116 9500
Milk and 24 m bccfu . 162 2600 110 9400
Milk with high conccnlrates’ 52 4100 142 11790
Milk and vculd 100 3900 144 11 500
Milk and cereal bccfu 1355 3100 120 9700
M1114 and 18 m bccf 150 1 3 000 120 9900
5’ Skin is included. 11cxc1udcd,va1ucs are reduced to about 70% ofvalucs shown.
b Skin is included. 11" excluded. values are reduced to about 800/0 of values shown.
5 Low concentrates, 900 kg/cow/ycar.
" The calves surplus to those needed to replace the milking herd are reared for veal,
ccrcal bccf,c1c. ’
5 High concentrates, 1650 kg/cow/year. ’
Source: Allaby,M.,World Food Resources,London 1977
V
LL

Protein yields from conventional and processed crops.
Crop yield Amomz/ Conwosilion 0f Yield/ha
(kg/lm) cum) 2edib/e portion
) ’ 2
(7H)
PIiO/L’m Energy" Protein Energy
(%) (MC(1//kg) (kg) (M600
(kmx’cmional crops
When! 4 000 70 7-9 3-49 220 9 800
Pounocs 25 000 86 12-1 0-87 450 18 700
Field beans 3300 100 27.0 2-70 890 8900
Vining peas 4500 100 55.8 0-64. ’ 260 2900
Navy beans 2000 100 21-4 ,2-58 430 5200
Cubbz gc 40 000 60 12-2 0-25 530 6000
!
Cropyie/d Protein GFOSTS yield Extraction Netyield
(kg/lm) (%) ofprorein ofprorein ofextracte’d
(kg/lza) (0/0) protein
(kg/ha)
Processcd crops 0
Soyu bczm 2 500 40 l 000 35 350
Dry muucr
Luccmc 8 000 22 1 760 60 l 060
Cocksfoon 9 000 16 1 440 ()0 860
__.._._ __ .,._ M... A. .-.-__ _._. .. __._-_.____________-
2 R4cui: 4WSFWJ. 0
Source: Allaby M.,World Food Resources,London,1977
ZL V

Nutritional value of vegetables
Vegetables make several important contributions to tropical diets:
(a) They enrich the diet with nutrients.
(b) They render the staple food more palatable ahd hence improve the intake.
(c) They improve the digestion.
(d) They sometimes have a curative action.
The addition of vitamins, minerals and other nutrients to the diet is the most important factor. In general. consumers do not realise the contribution that vegetables make to the nutritive value of their diet. This is more generally acknowledged in developed countries.
The composition’of some vegetables, compared with that of cereals, tubers and pulses, is presented in table 4. This indicates that vegetables may contain important additions to the nutrients which are insufficiently available in basic foodstuffs. However, it is not easy to provide a general estimate of their,nutritive_valuemiuwtropical diets. Table Swillustretes the relative importance of the different vegetable groups and species. The composition and nutritional value of vegetables may be broadly summarised as follows:
(1) The dry-matter content of vegetables varies considerably with the Species or cultivar as well as with climatic and soil conditions during growth, cultivation methods, harvesting, storage treatments etc. The analyses relate to the cleaned, unprepared edible portion.
l
(ii) The waste includes_the basal stem portion and rootlets of leafy vegetables. trimmings and outer leaves of cabbage and lettuce, scrapings of carrot roots, parings of cucumber and pumpkin, :ops and strings of bean pods, shells of Lima beans, skins and trimmings of onions, etc. The percentage of waste varies from AZ for eggplant to 442 for bamboo shoots. The overhead loss in produce, i.e. unsaleable and deteriorated material and the part reserved for seed production, amounts to an average of 20% for all vegetables. The approximate consumption of purchased vegetable produce is probably 802 of the total production.
(iii) The composition of vegetables in both the fresh condition and based on a dry matter content varies considerably, although the same type of product, such as dark green leaves, fleshy white or green cucurbit fruits, leguminous pods or white fleshed tubers, show great similarity in composition.
(iv) The protein content of vegetables is considered to be relatively un_ important in developed countries. but it appears to be highly important in countries with an overall deficiency in proteins. The amino-acid composition of many vegetables is well balanced, rich in methionine and lysine and with a fairly high biological value, viz. about 60X of the reference protein.
(v) The fibre content is less important in the tropics than it is in developed countries, due to the generally coarser nature of prepared food in the tropics. In this context, it should be noted that a high intake of fibre effectively prevents constipation and digestive problems. ’

(vi) The important minerals, calcium and iron are often lacking in diets in the tropics. Calcium deficiency may occut more frequently if the basic food consists mainly of cereals. A high iron intake is important since anaemia caused by malaria, bilharzia and intestinary parasites occurs very frequently. Pulses such as coupea are rich in' calcium and iron.

(Vii) 0f the vitamins, p-carotene and vitamin C are the most important. Carotene is deficient nearly everywhere in the tropics, with the exception of W. Africa where red palm oil is used in food preparation. The low intake of fat hampers the absorption of carotene in the body. Vitamin C is less abundant in cereal than in tuber-consuming regions.

(viii) Pharmacological substances may also be important, but there is still insufficient data available on the nutritional value of natural plant products.

Several authors have developed formulae for the average nutritive value of vegetables. HacGilIivray 33 11' (1942) suggested a formula, based on a rating of nutrients in 25 vegetable species in the USA. In the present study the fdrmula of Rinno (1965) is used: this is based on the average nutrient requirements in W. Europe, but can also be applied to the tropics, with some exceptions, and special situations. Rinno's formula for the 'Essential Factor of Nutritive Value' here called 'Average Nutritive Value' per 100 g of vegetable ls: .

g grotein , H mg Caw mg Fe 7 img_glgLQV ,3,'
ANV' 5 t g fibre e 100 e 2 t mg carotene t
l

Notwithstanding its limitations, the ANV in table 5 presents an acceptable picture of the relative importance of different vegetables. The best estimate for the potentional production of valuable nutrients by various vegetables can be obtained by calculating the ANV per unit of area, per man day per unit input of capital and energy, but adequate data for such calculations are not available. However, an evaluation of the patential production per day of cultivation is presented in table 6 (ANV per m per day). The group of dark-green leaf vegetables has the highest ANV figures, based on both fresh and dry matter; this group is obviously the best nutrient supplier. Sweet peppers rate a high score as producers of nutrients, owing to their high vitamin'C content, while carrots are rich in carotene. Either a quantitatively very high production (cucumber) or a short growing season (lettuce) may compensate for a low nutritional value. The group of leguminous vegetables ranks lowest in this classification. Other vegetables with a low production of nutrients are watermelons, eggplants and, although containing a high 3-carotene content, pumpkins.

Source: Grubben G.J.H.,Tropical Vegetables and their
Genetic Resources,IBPGR,Rome, 1977

Tablc. 0. Composition of some vegetables, compared with pulses
and starchy foods. From PLATT (1975).
Requirements for an adult man (55 kg) from FAO/WHO
standards for East Asia; protein biol. val. 602
p e r 100 g o f e d i b 1 e p o r t 1 o n
dry
_ .. V .
product matter energy pro- fibre 031- iron caro- :21: Eiboi niacin it C
tein cium ten: m ne av ne
Kcal g 3 1mg mg mg mg ms m8 m8
M
starchy basic food
maize 88 362 9.5 1.5 12 2.5 0 0.35 0.13 2.0 0
rice 88 354 8.0 0.5 10 2.0 o. 0.25 0.05 2.0 0
cassava 40 153 0.7 1.0 25 1.0 o 0.07 0.03 0.7 30
sweet potato 30 114 1.5 1.0 25 1.0 0.06 0,10 0.04 o_7 30
pulses
groundnut’ 55 332 15.0 1.5 30 1.5 0 0.50 0.10 10 o 10
coupes 90 340 22.0 4.0 90 5.0 0.01 0.90 0.15 2.0 0
vegetables
.dark-arun leaves 15 as 5.0 1.5 250 4.0 1.80 0.10 0.30 1.5 100
tomato 6 20 1.0 0.6 5 0.4 0.15 0.06 0.00 0.7 25
okra 10 33 2.0 1.0 70 1.0 0.09 0.10 0.10 1.0 25
green beans in pod 10 34 2.0 1.0 50 1.0 0.12 0.08 0.12 0.5 20
daily requirements 2,530 46-0 - 500 9 1.5 1.0 1.5 17 30
5
Source: Grubben G.J.H., Tropical Vegetables and their 2
Genetic Resources,IBPGR,Rome,l977

Table 5.
_____-__-__g_-___-_t_____-_____________7__FT5:______-____
energy rein fibre Ca
M
type of produce waste DM
Z 8
fruit-vegetables
tomato 6 6.
eggplant 4 8.
sweet peppers l3 8
pepper, hot 13 34.
okra 10 10.
cucumber 20 3.
pumpkin 17 8.
watermelon 37 6.
melon(uhite-green) 22 7.
bitter gourd 20 6.
leafy vegetables
amaranth 40 10.
kangkong 28 10.
Chinese cabbage, 14 5.
leaf type
lettuce 26 6.
white cabbage 15 7.
cassava leaves 13 19
legumlnous vegetables
hyacinth bean
Lima
mung bean
bean (fresh) 43
sprouts, bulbs, tubers, etc.
onion (dry) 6 11.
carrot 17 10.4
bamboo shoots 44 9.
mushroom 9 11.3
taro (as vegetable) 16 26,
Source:
(dry) 0 87.
(sprouted) 7 9.
00002400500079
Average nutritive value 06 vegetables. Data from:
Food composition table for use in East Asia (FAO.
Kcal
20
26
26
116
31
12
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334
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94
OHOOOHONKHHP
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PWH

NNNWH
me
8
mOONONmUwONN
VNG
0ND
NQMHO
per 100 g edible portion
caro- 8-
1ron tene mine
8 m8 m8 m8 mg
0.7 7 0.6 0.5 0.06
1.0 22 0.9 o 0.08
1.4 12 0.9 . 1.8 0.07
15.0 86 3.6 6.6 0.37
0.9 90 1.0 0.1 0.07
0.5 21 0.4 0.1 0.03
0.8 24 0.7 0.8 0.03
0.2 8 0.2 0.1 0.03
0.5 18 0.5 o 0.05
1.0 26 2.3 0.1 0.06
1.3 154 2.9 6.5 0.04
1.1 60 2.5 2.9 0.09
0.7 102 2.6 2.3 0.07
0.6 56 2.1 2.0 0.06
0.8 55 0.8 0.3 0.06
2.1 144 2.8 8.3 0.16
6.8 98 3.9 0 0.40
1.0 25 2.2 0.1 0.16
0.9 15 1.2 0 0.11
0.7 30 1.0 0 0.06
0.9 36 1.2 4.2 0.06
1.2 17 0.9 0 0.11
0.9 8 1.0 0 0.10
0.8 34 1.2 0 0.12
Grubben G.J.H., Tropical Vegetables and their
Genetic Resources,IBPGR,Rome,1977
r o-
flavin
mg
0.04
0.07
0.08
0.51
0.08
0.04
0.04
0.03
0.02
0.04
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0.16
0.13
0.12
0.06
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0.16
0.10
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0.05
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OOOOOONOOO
1972).
niacin vit.C
mg mg
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6
103

96
18
11
14
6
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57
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23
47
53
OHO
meJ
17
46
82
POO
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30
18
OFIH
covvcn
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muxoono
ANV
2.39
2.14
6.61
27.92
3.21
1.69
2.68
0.90
2.33
4.10
11.32
7.57
6.99
5.35
3.52
16.67
14.03
4.88
2.94
2.05
6.48
2.55
2.10
2.38
ANV
per 100 g
dry
matter
38.5
26.8
82.6
80.7
30.9
44.5
33.1
13.2
30.7
68.3
105.8
75.7
120.5
83.6
50.3

87.7
16.0
17.9
34.2
20.0
64.2
30.9
19.3
9.7
SL

Pbtenclal yield of valuable nutrients from vegetables.
Average Nutritive Value (ANV) from table 5.
Yield data recorded as "high production" in USA
For the tropical vegetables (8) records of the Horticultural
Centre, Porto-Novo, Benin (U.Africa) have been used.
11e1d clha ANV 2
ed 1e ANV duration per m
. 2
vegetable gross portion ANV per m davs per day
____
f1eshy fruits
tomato 45 42.3 2.39 1013) 160 0.63
eggplant 25 24.0 2.14 51 200 0.27
sweet peppers 30 26.1 6.61 173 130 1.33
okra 15 13.5 3.21 43 90 0.48
cucumber 50 40.0 1.69 68 150 0.45
pumpkin 20 16.6 2.68 44 150 0.30
watermelon . 40 25.2 0.90 23 120 0.19
leaf vegetables
0)amaranth 30 18.0 11.32 204 .’ 50 . 4.08
4)kangkong 80 57.6 7.57 436 270 1.61
Chinese cabbage 30 25.8 6.99 180 90 2.00
lettuce 20 14.8 5.35. 79 50 1.58
ghite cabbage 40 34.0 3.52 120 90 1.33
k)cassava 10aves ’ 60 52.2 16.67 870 270 3.22
leguminous vegetables
asparagus bean (pods) 7 6.2 3.74 23.0 150 0.15
lima bean (fresh) 9 b) 5.1 4.88 25.0 210 0.12
mung bean (sprouted) 2-5 20.9 2.94 61.5 110 0.56
t)hyacinth bean (dry) 3 3.0 14.03 42.1 180 0.23
bulbs, tubers
onion 40 38.4 2.05 78.7 150 0.52
carrot 20 16.6 6.48 107.6 90 1.20
taro 20 16.8 2.38 40.0 120 0.33
turnip 13 10.3 2.03 20.9 80 0.26
______________________#____1______._____
_ 7
a) ANV (for 100 g) x edible portion (t/ha) : total ARV per m"
b) 1 kg of dry mung bean produces 9 kg of sprouted beans
Source: Grubbgn G.J.H.,Tropical Vegetables and their
Genetlc Resources,IBPGR, Rome 1977