

R2036-2(s)

**Root and tuber crops for
livestock feeding in Vietnam
Part 2. Field survey in Nghe An
province**

19 February - 10 April 1993

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Project No: A0304

TABLE OF CONTENTS

	Page
Abbreviations	3
Summary.	4
Introduction.	7
Structure of survey.	9
Results of the survey.	9
Climate and soil.	9
Householder details.	11
Small-holder farm details.	12
Inputs to crop production.	12
Outputs from crop production.	15
Livestock holdings and inputs to production.	16
Outputs from livestock production.	19
Value of livestock.	20
Constraints of crop and livestock productivity.	21
Conclusions.	22
References.	23
Figure 1. Map of Nghe An province showing location of surveyed districts.	10
Figure 2. Crop calendar illustrating planting and harvesting times of major crops within communes in Nghi Loc and Nam Dam districts.	13
Appendix 1. Climatic conditions at Vinh City, Nghe An province averaged over 1981-1991 period.	24
Appendix 2. General details of farm householders surveyed in communes within Nghi Loc and Nam Dam districts.	25
Appendix 3. Average household farm details of farmers surveyed in communes within Nghi Loc and Nam Dam districts.	26

Appendix 4. Average major crop yields and proportion of nominal value of farmers surveyed within Nghi Loc and Nam Dam districts.	27
Appendix 5. Fate of cassava and sweet potato crops from farmers surveyed within Nghi Loc and Nam Dam districts.	28
Appendix 6. Livestock facilities, housing areas and condition data for farms surveyed within Nghi Loc and Nam Dam districts.	29
Appendix 7. Feed ingredient use (as % farmers using) on householders surveyed in Nghi Loc and Nam Dam districts.	30
Appendix 8. Current production of livestock on farms surveyed within Nghi Loc and Nam Dam districts.	31
Appendix 9. General data relating to income status of household farmers surveyed in communes within Nghi Loc and Nam Dam districts.	32
Appendix 10. Comparative value of crop and livestock products on surveyed farms within Nghi Loc and Nam Dam districts.	33
Appendix 11. Price and availability of animal feedstuffs and fertiliser.	34

ABBREVIATIONS

AHRI	- Animal Husbandry Research Institute, Hanoi.
AI	- Artificial Insemination.
CIAT	- Centre for Tropical Agriculture, Colombia.
CGPRT	- Centre for Research and Development of Course Grains, Pulses, Root and Tuber Crops in Humid Tropics, Bogor, Indonesia.
DAP	- Diammonium phosphate (fertiliser).
DM	- Dry matter
HCM	- Ho Chi Minh City.
LW	- Large White breed (pig).
LWT	- liveweight.
MC	- Mon Cai breed (pig).
NPK	- Nitrogen phosphorus potassium (fertiliser).
UA #2	- University of Agriculture, Hue.
UNDP	- United Nations Development Programme.

SUMMARY

1. This survey was carried out in Nghe An province as part of an assessment of the potential for increasing the performance of root crop based animal feeding systems. The province is one of the largest producers of sweet potato and cassava in Vietnam and relies on root crops for over 25% (rice equivalent) of its food crop production capability. Nghe An is within the bottom quartile of province wealth ranking, with farmers having an average nominal household income of \$250 per annum.

2. Two districts were surveyed. Nghi Loc district is 30 km north of Vinh and has major crops of rice, sweet potato and groundnut. Nam Dam district lies 20 km east of Vinh and has major crops of rice, cassava, sweet potato and groundnut. At least ten farmers from each of four villages per district were interviewed. The size of farms surveyed ranged from 0.23 to 1.36 ha and consisted of a house and garden and a number (4-12) of scattered fields ranging in area from 300 to >1000 m². Land is controlled through the commune under a 10-15 year contract arrangement.

3. Rice represents between 60 and 70% of total crop output; two crops are planted per year, with harvesting in October/November and in April. Sweet potato is grown as a rotation crop with rice, being planted in December/January and lifted after a 5 month growth cycle in May/June. Cassava is planted in January/February and lifted in December. Cassava can act as a food reserve in response to adverse weather.

4. The total root and tuber crop over the eight villages surveyed represents 28% (rice equivalent) for the food crop production and 19% of its overall value. The combined sweet potato and vine crop has a similar cash value to rice. Fresh cassava returns 8% of the overall crop value from 18.3% of the food crop weight (rice equivalent) or 34% of the overall food crop harvested weight. Average yields of sweet potato range from 4.7 to 5.9 T per ha and yields of cassava average 7.5 T per ha; both are below the national averages (6T and 9T per ha respectively). Low yields result from the use of poor soil and low productivity cultivars combined with low inputs of manure and fertiliser, which are used preferentially for the rice crop.

5. Both sweet potato and cassava are cash crops; over 70% of the sweet potato crop is sold. Approximately 90% of the cassava crop is sold, largely in the form of sun-dried chips which may be retained over the current harvest season. Approximately 30% of the dried product becomes mouldy due to slow drying; the transfer of more cassava to on-farm feeding

would require the introduction of better preservation technologies.

6. Livestock are kept by over 90% of householders, in covered pens attached to the main dwelling. An average of 1.6 cattle or 1.3 buffalo are kept by 60% of farmers for draught purposes; manure is a secondary product. Pigs are more uniformly distributed, averaging 1.8 growing pigs within 90% of households. Sows are kept by 20% of farmers; sow productivity is very variable with performance in the better communes similar to that reported as standard.

7. Cattle are normally fed on grasses or untreated rice straw; they may be given old sweet potato root and sweet potato vines with rice bran as dry season supplements.

8. Approximately 50% of the cassava crop is fed in the form of the sun-dried chips to pigs, in addition to kitchen waste and rice bran. Sweet potato tubers are cooked prior to feeding to pigs with kitchen waste and rice bran. Sweet potato vines and tips are fed to pigs in both districts as a protein and vitamin supplement; older vines at harvest are given to ruminants. Growth rates in growing pigs average 320 g per day, which reflects poor facilities and lack of feed.

9. Growth rates of 500 g per day in growing pigs should be achievable using protein supplements to low nutrient density rations based on cassava and sweet potato. Both districts have access to protein sources, such as rice bran, groundnut cake and whole soya bean, although the latter two are seasonal. Nghi Loc has better access to poor and good quality fish meal. These protein sources could be spared by greater use of sweet potato and cassava leaf forages, although this may not be cost effective under production conditions.

10. Lack of affordable credit was seen by farmers as the major problem restricting both crop and livestock productivity. Poor soil productivity and lack of irrigation were given as further restraints to increased crop production. The lack of a stable market for cassava was given as the main reason for discouraging any increase in its production.

11. Poor stock quality and the lack of appropriate feedstuffs were recognised as important factors limiting increased livestock productivity. The introduction of improved livestock practices would need to be targeted at women's groups. It was accepted at the commune level that an increase in livestock production would require the development of existing markets outside the Province.

12. Proposals for increasing livestock productivity through better utilisation of sweet potato and cassava in livestock feeds are developed in Part 1.

INTRODUCTION.

1. Nghe An province is situated 300 km south of Hanoi in the central northern and coastal region. Nghe An and the more southerly Ha Tinh provinces were split from the single province of Nghe Tinh in 1991. Nghe An province covers a total area of 17,200 km² and is administered through 18 districts which stretch westwards from the coast to the Laos border (Figure 1.). There are major road and rail links to Hanoi (6 hours) and Hue (8 hours) and minor road links via Ky Son to Northern Laos and via the Ked Nua Pass to Southern Laos. The 82 km of coastline supports an inshore fishing sector landing 54,000 tonnes annually of fish products (prawns and small fish) and a major tourist development at Cualo beach.

2. Over 85% of the total of 499,400 households in the province are engaged in agriculture. The low productivity of the agricultural sector is reflected in National statistics, where average food production per capita, at 218 kg paddy equivalent per head, is in the lowest quartile of individual provincial production. Approximately 187,000 ha of land is cultivated; this can be divided into ten broad regions containing more than 30 types of land. The upland and highland regions to the west cover 80% of the province area; these are thickly forested and are home for a number of minority groups. These households keep livestock and grow subsistence crops such as cassava; a major source of their income is firewood.

3. The majority of the provincial population (2.6 million total) live on the coastal plane, and grow main crops of rice (irrigated and dryland), groundnut and sweet potato. The 51,000 ha of land currently planted to sweet potato is the largest planted area in Vietnam. Much of the crop is planted on light, sandy soil producing an average yield of 4.7T per ha, which is considerably lower than the 6T per ha national average. Cassava is grown on the poorer and dryer soils of the upland regions as well as the more marginal soils found in most districts. Currently 21,000 ha are planted to cassava; this is a similar area to the largest plantings in the major cassava producing provinces of Dong Nai and Binh Dinh in the South. The average yield of 6T per ha is well below the 9.0T per ha national average.

4. Livestock are integrated with crop production, providing draught power, manure and meat; there is no dairy sector. The livestock population of the province consists of 420,000 cattle and buffalo and 570,000 pigs which represents the 10th highest provincial per capita livestock holding at 1.4 livestock units (LU) per household. The distribution of cattle is not uniform, with a higher proportion of breeding animals being found at higher elevations and occasionally within small fattening enterprises. Pigs are more uniformly

distributed between households, although there are differences in the extent of use of exotic crossbreeds between districts.

5. Rice production dominates agriculture, representing 80% of food production; average production is 2.2T per ha which is lower than the regional (agro-ecological zone IV) average of 2.5T per ha. Root crops are responsible for 16% of crop production on a rice equivalent basis (36% on bulk crop basis). Farmers in Nghe An have one of the lowest average per capita incomes in Vietnam. Average income of farmers was US\$ 250 per household per annum in 1992, compared with the National average of US\$ 350. Monthly per capita expenditure on food in 1990 was equivalent to 12.0 kg of rice, compared to a National average of 14.0 kg; monthly meat consumption per capita was 0.22 kg compared with 0.63 kg for fish. These averages disguise the fact that 30% of the population may suffer transitory malnourishment at specific periods between crops.

6. Average annual incomes of non-agricultural occupations (\$US 300) were at least 35% below the National average (US\$ 480). Monthly per capita expenditure on food was 11.49 kg rice equivalents compared to 11.84 kg nationally. Monthly per capita consumption of meat (0.55 kg) and eggs (1.46 pieces) was lower than the National monthly averages of 0.77 kg meat and 1.72 pieces respectively. Fish (0.73 kg) and vegetable (3.26 kg) consumption is the same as the national average. The local market for cash crops and livestock products is close to saturation; between 5 and 15% of agricultural products (excluding rice) is exported from the province to other regions.

7. The Province Committee see tourism, fishing and agriculture as growth areas over the next five years. Nghe An has been set a 3% per annum target for increase in agricultural production under the National Plan. The introduction of more efficient small-holder livestock enterprises based on root and tuber crops is seen as a useful contribution to this target and of increasing local income. It is accepted that the improvement in the root crop sector will require corresponding developments in the general agricultural resource base. The University of Hue (UA #2) and the Animal Husbandry Research Institute (AHRI) have established direct links with the provincial agriculture and technology transfer services. The increase in agricultural production will not be matched by an increase in local consumption, which is estimated to rise by 1% per annum. Assistance is required in expanding the existing markets in other provinces and for the establishment of other cash crops such as fruit.

STRUCTURE OF THE SURVEY.

8. The districts of Nghi Loc (30 km north from Vinh city) and Nam Dam (20 km east from Vinh city) are representative of areas where sweet potato and cassava are widely grown (Figure 1.). Discussions were held with district and commune representatives in order to select communes and villages which reflected the spread of economic status in the district and which would be keen to participate in the first collaborative farmer trials. The villages of Fong Thai, Fong Tinh (Nghi Fong commune), Bac Ky La, Tan Son (Nghi Van commune) were surveyed in Nghi Loc district; these are approximately 20 km from the coast. The villages of Xom 5, Ranhrahm (Nam Thanh commune), Hung Thanh and Lam Son (Nam Hung commune) were surveyed in Nam Dam district; these are approximately 40 km from the coast.

9. Village officials selected farms which were representative of the range in farm size and status. A minimum of 10 householders from two villages from each commune were interviewed based on a questionnaire (48 questions). The design of the questionnaire was similar to that used for the cassava survey by the Centre for Tropical Agriculture (CIAT) in 1991 and the sweet potato survey in 1989 by the Centre for Research and Development of Course Grains, Pulses, Roots and Tuber Crops (CGPRT) in 1989. Questions concerning livestock feeding or production were substituted for those related to the detailed cost of cassava or sweet potato production.

10. The interviewing teams consisted of the author, a member of AHRI, a member of the provincial technology transfer service and a district committee officer. Households were surveyed at random within rich and poor groups which were identified by village leaders. Householders were interviewed in their main dwelling over tea. Animal holding facilities and gardens were inspected at the end of the interview.

11. The results of the survey are tabulated in Appendices 2 to 11. Information from each is integrated within the text.

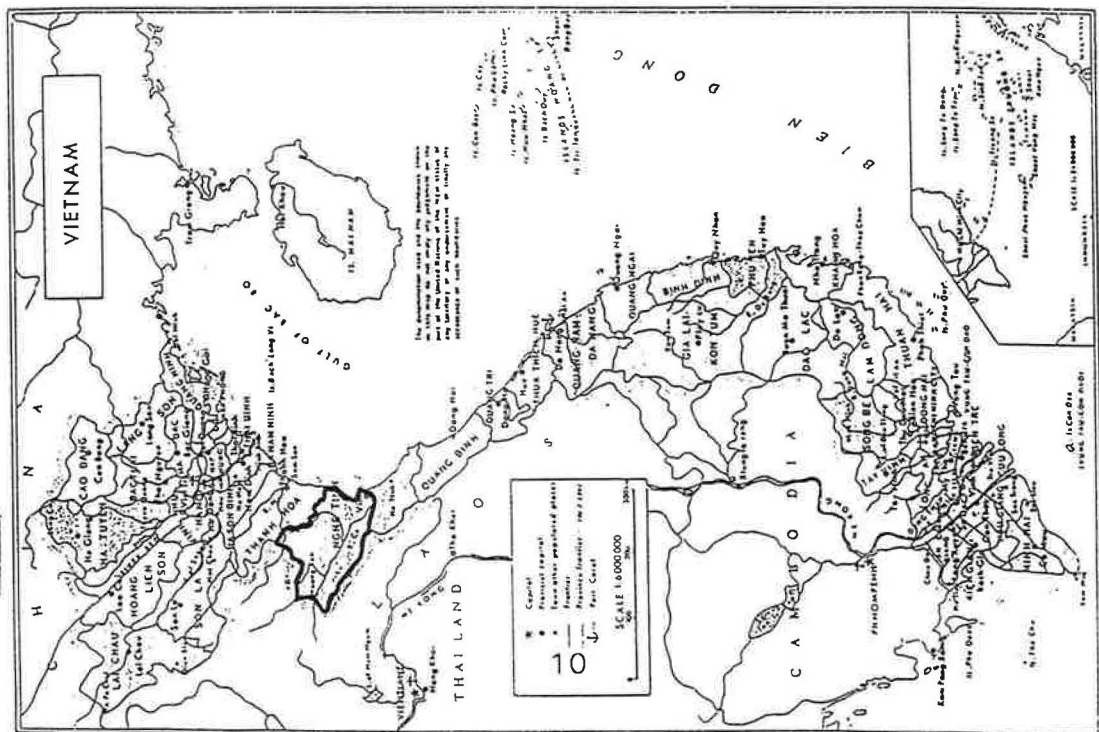
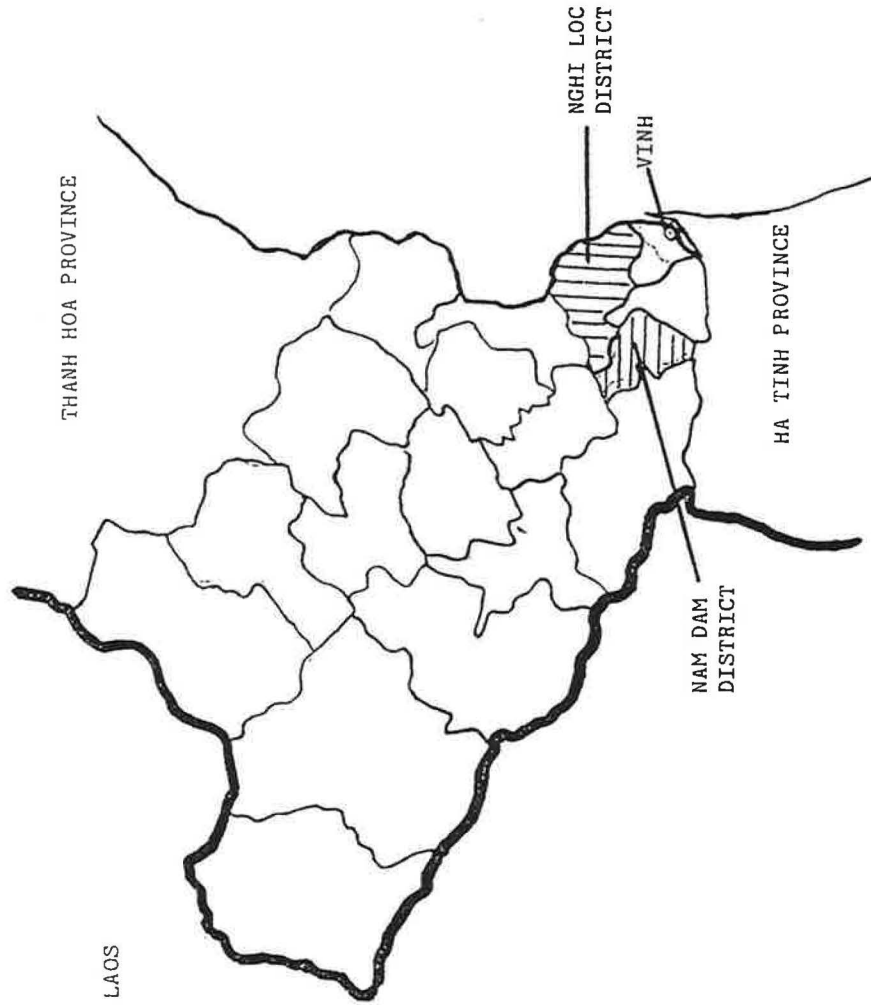
RESULTS OF THE SURVEY.

Climate and soil:

12. The main factors relating to the semi-tropical climate of the province are given in Appendix 1. The area receives a high proportion of its rainfall during the August to November monsoon; this is associated with frequent tropical storms and typhoons (on average 5-6 per year) that cause damage and extensive flooding. Maximum temperatures in excess of 30°C are experienced over the May to September period due to a prevailing hot drying wind from the west. Low temperature, high humidity conditions occur from

Figure 1

Map of Nghe An Province showing location of surveyed districts.



November to February under the northerly influence of cooler weather from China.

13. Soil types vary within the districts although light sandy soils predominate. Colours range from reddish brown to greyish white; in some areas the soils are stony.

Householder details:

14. Households comprised between two and ten persons although the majority contained two adults (husband and wife) and three or four children (Appendix 2.). The main occupation of both adults was cultivation of crops; only one householder had business interests. Approximately 15% of householders have to supplement their income; this is necessary where the supply of land is limited (Nghì Fong commune) or the soil is poor (Nam Hung commune). Income may be earned by labouring in non-agriculture industries (e.g. quarrying - \$US 1.5 per day) or through artisanal crafts such as basketry. Approximately 10% of farmers rent their cattle and buffalo (average \$US 1.2 per day) for crop movement and cultivation.

15. Over two of the children were at school giving an average attendance ratio in the under 16 age range of 79%. The National combined primary and secondary education enrolment ratio is 69% (this ratio is 43% in least developed countries and 72% for developed countries - UNDP statistics). Primary education below twelve years of age is compulsory and free. Older children below sixteen years of age attend school on a fee paying basis. School fees average \$US 10 per child per year, representing between 10 and 25% of the declared expenditure in some households, and where made, are the highest single call on disposable income. The majority of farmers are literate and numerate, although this may not extend beyond the ability to complete crop returns to the commune. Over 20% of householders own a radio; news and agricultural information is obtained through commune meetings and neighbours.

16. Households farms consist of a house and garden area, with other separated cultivated areas. Over 80% of households in the communes surveyed own a partly block-built house, often with a tiled roof. A hard surface drying area is situated at the front of the house. Livestock are kept by over 90% of households in annexes next to the main house or less frequently in separate outbuildings. Garden areas range from 600 to 1800 m²; this provides an area for vegetable production and for additional cash crops.

17. Less than 4% of households own motor-cycles; these are used for carrying larger items such as live pigs to market. Over 85% of householders own a bicycle for the movement of bulky crops such as sweet potato vines and firewood. The

majority of manure and crop movement between house, fields and markets is still made by hand (by women).

Small-holder farm details:

18. Farm areas range from 0.23 to 1.11 ha in Nghi Loc and 0.25 to 1.36 ha in Nam Dam district; the average farm area is 0.64 ha (Appendix 3). The general cropping pattern depends on land quality and is predominantly directed towards rice production (Figure 2). All households harvest two rice crops per year off better quality land, the major harvest being in November. Sweet potato is usually grown as a rotation crop with winter rice (replacing spring rice). This rotation has been replaced on less light soils by winter rice followed by groundnut. Cassava is grown on poorer quality land as an annual crop. There is limited use of fallow.

19. Householders have a share of better quality (rice producing) areas of land and access, where available, to areas of poorer quality land. Farms consist of between four and 12 cultivated 'fields'; these range in size from 300 m² to >1000 m² (for cassava). Farm areas are larger in Nam Dam district due to the higher component of poorer land used for cassava cultivation. Walking distance between the house and 'fields' varies from 500 m to over 3 km in the case of some upland cassava fields.

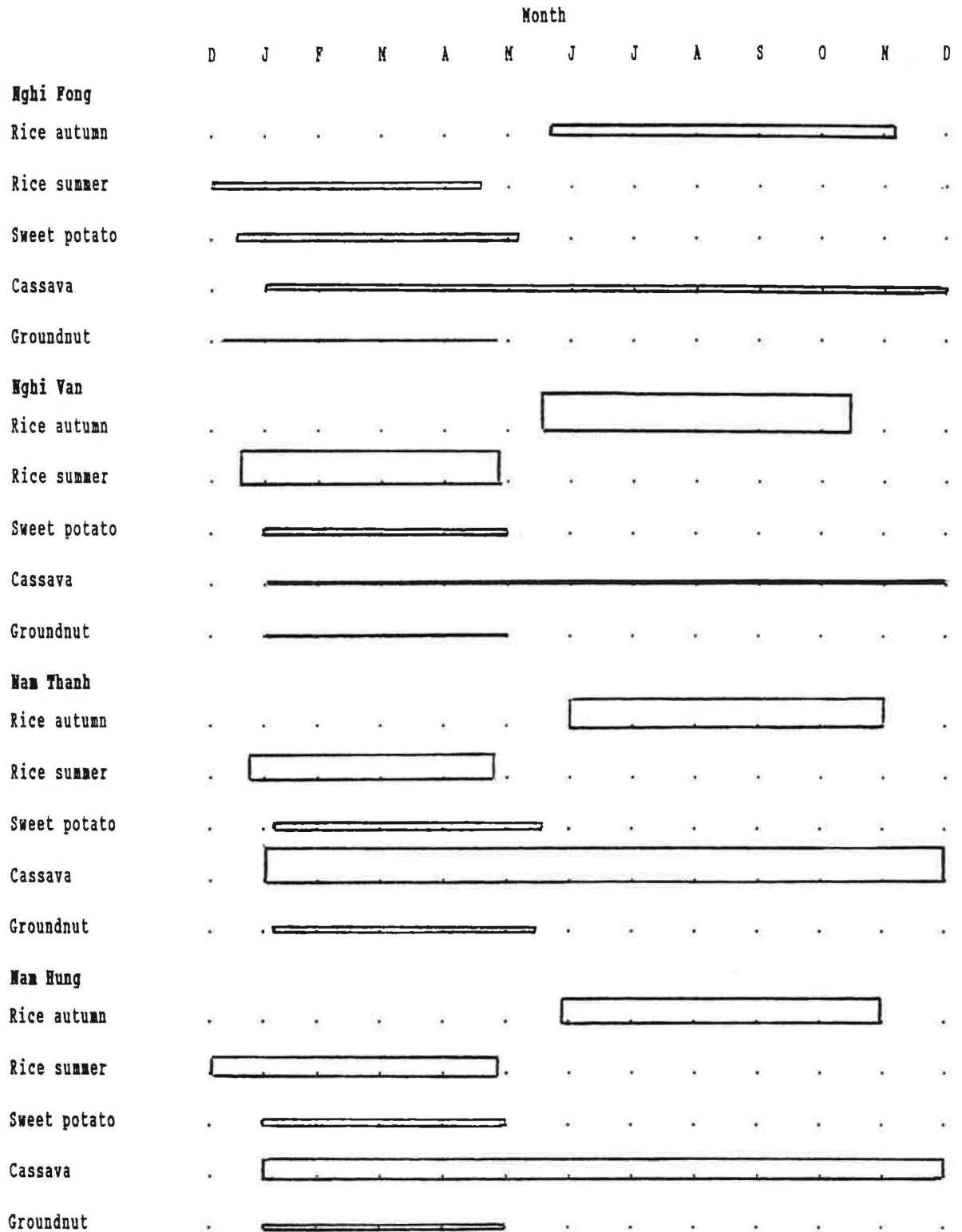
20. Cropping areas over the surveyed farms ranged from 0.19 to 1.34 ha; cropping areas for rice average 0.35 ha. Planting areas for sweet potato in Nghi Loc district averaged 0.11ha and for cassava in Nam Dam district average 0.28 ha. Farmers control the land under agreement within the commune; these 'contracts' last for 10-15 years and take the form of a land tax (levy) based on assessed crop production. The levy includes district services, such as irrigation, artificial insemination (AI) centres, schools and health centres. The land tax of surveyed house-holders ranged from \$US 13 to \$US 49 per annum and is highest (on a per ha basis) in Nghi Van commune which has the highest irrigated area. The levy is payable biennially directly after the rice harvest.

Inputs to crop production:

21. Rice is the major crop for food production (Appendix 3.); the winter crop represents 75 and 40% of the planted farm area in Nghi Loc and Nam Dam respectively. The main winter crop is planted in May/June (Figure 2.); the spring crop is planted in December. The winter crop is harvested after 5 months in October/November; spring rice is harvested in April after a shorter 4.5 month growing season. Approximately 50% of farmers use improved (1820; 205 - Bac Thai) varieties. Manure and fertiliser are applied *a priori*

Figure 2.

Crop calendar illustrating planting and harvesting times of major crops on farms surveyed within Nghi Loc and Nam Dam districts.



to the winter rice crop; 80% of households surveyed apply manure at an average rate of 5.5T per ha to winter and 4T per ha to spring rice. Fertiliser (Diammonium Phosphate - DAP or NPK) is applied to the winter crop at an average rate of 190 kg per ha and 160 kg per ha to summer crop.

22. Sweet potato is grown on 26% and 10% of the average planted area in Nghi Loc and Nam Dam respectively. It is cultivated in rotation with rice, where it now provides a valuable break crop in the integrated control of disease. Sweet potato is grown over the winter spring season, with cuttings being planted in December and January. Approximately 5% of farmers reported the use of a crop planted in July; this is tolerant of flooding in September. Improved cultivars (Chiem Dau and Hoang Long) are used by all farmers.

23. Sweet potato tubers are normally harvested after 5 months growth, although on very light soil this period may be shortened due to drought stress. Vines and vine tips are taken as thinnings for vegetables and pig feed over the season. Manure is applied by 50% of farmers who use it at an average rate of 6.8T per ha; 30% of farmers apply fertiliser (NPK), with an average use of 110 kg per ha. There is considerable variation in the application rate (60 to 500 kg/ha), due to shortage of cash and/or a shortage of manure.

24. Cassava is planted on 35% of the cropped area in Nam Dam district; the stakes are planted in January/February and harvested after a 10 month growing cycle. A high proportion (75%) of householders apply manure at an average rate of 5.4T per ha. Manure is worked (not dug) into the top soil. Fertiliser (NPK or more usually urea) is applied by <40% of householders; NPK is applied at an average rate of 140 kg per ha. One local cultivar (Mi trang) is used extensively; improved cultivars (e.g. HL 20) are used by 5% of farmers. Harvesting normally takes place over the November to January period, although crops from late plantings may be left until March. Cassava is not intercropped for other crop production or weed suppression.

25. Groundnut is now grown on 12 to 15 % of cropped area, and has partly substituted sweet potato where soil fertility permits. The crop is planted on light sandy soil in January and harvested in June. Only 30% householders apply manure (average rate 4T per ha); fertiliser (NPK) use is widespread, averaging 120 kg per ha.

26. An average of 63 and 69% of farm labour is used for crop production in Nghi Loc and Nam Dam districts (Appendix 9). The highest requirement occurs over the November to February period, where the winter rice harvest is followed by land preparation and planting. Cassava growers also lift the majority of the crop over this period. Both adults are fully

committed to field operations over the rice and root crop harvest and in subsequent field preparation and planting. Women (and children) must take on an increased role when the husband has another occupation. No use of exchange labour was reported. Only 5% of farm households in Nam Thanh commune, with large cassava fields, reported the hiring of labour for tuber harvest and field preparation.

27. Farmers reported that expenditure associated with crop production (land tax and crop costs - no family labour cost) averaged between \$US 40 and 125 per annum. Fertiliser appeared to account for between 50 and 55% of this expenditure.

Outputs from crop production:

28. The average yield of winter rice is 2.5T per ha (Appendix 4); individual household yields range from 1.1 to 4T per ha, the higher yield being obtained through irrigation, appropriate use of manure and fertiliser and good pest and disease control. The average rice yield represents between 60 and 70% of total food crop production and is 65% of crop value. The extensive use of irrigation in Nghe Van commune resulted in rice being 75% of total crop value. Rice bran represents the largest single local source of protein available for livestock feeds; rice production is unlikely to increase in Nghe An province by more than 1% per annum.

29. Yield of sweet potato in Nghi Loc district averaged 4.8T per ha, which is 20% below the national 6T per ha average; higher yields in Nam Dam (average 5.9T per ha) result from the higher relative application of manure. Yields of 8T per ha were claimed on farms in Nghi Van through the use of irrigation. Low yields reflect poor local cultivars; there appears to be no serious loss in yield through virus weakening. The sweet potato crop varies between 6 and 23% of the average crop yield and averages 13% of the crop value (rice equivalent).

30. At least 60% of the tuber crop is sold by farmers, either in the fresh or sun-dried form through middle-men (Appendix 5). The whole crop retained for 'on-farm' use (17 to 38% of total output) represents an average of 39 to 79 kg dry matter tuber, which is available for human or animal feed. At least 70% of farmers in Nghi Loc district sell vines, and 50% sell vine tips. Farmers in Nam Dam district retain all vines for household consumption or for the supplementary feeding of ruminants and for inclusion as a protein source in monogastrics. The combined cash return of the dried tuber, vines and tips is probably equivalent to that of dryland rice.

31. The average yield of cassava is 7.5T per ha, although widely ranging yields from 6 to 14T per ha were reported. In Nam Dam district the crop represents 29% of average crop yield (rice equivalent basis) and is 13% of the total crop value. Up to 45% of the crop in Nam Dam is sold fresh, although only half of this is sold in the local market. Approximately 20% of the crop is sold through middlemen who arrange bulk collection for delivery to industrial starch producers. Fresh cassava for industrial use is sold for less than \$US 0.01 per kg compared with up to \$US 0.02 at market.

32. Over 45% of the cassava crop in Nam Dam district is chipped by hand, sun-dried and sold as human or animal feed. Drying increases the net return on dry matter by 30% (\$US 0.02 per kg fresh; \$US0.08 per kg dry) although this margin is seriously reduced by losses due to poor drying. Cassava is harvested in a period of limited sunshine and high relative humidity; drying takes at least 3 days during which time up to 30% of the product may become partially mouldy. The problem is accentuated by the heavy labour commitment to other crops at this time. Currently between 50 and 100 kg of cassava dry matter is retained by farmers as dried chips for human or animal feed purposes. A level of mechanisation and better drying technologies would have to be introduced if a higher proportion of cassava was to be processed for 'on-farm' use in livestock feeds.

33. Yields of groundnut average 1T per ha which is similar to the National average; the crop represents 5% of the yield but 14 % of value although there are high relative support costs in terms of fertiliser and disease control. The crop is sold to middle-men for consolidation prior to hand sorting for export and oil extraction and groundnut cake production using broken or substandard nuts. The oil extraction process is artisanal and somewhat seasonal. The potential for aflatoxin contamination is restricted due to the dry harvesting period, appropriate storage of the crop and a limited storage period of the de-fatted meal.

Livestock holdings and inputs to production:

34. Cattle and buffalo are kept in more than 70% of households for draught purposes (Appendix 6); buffalo are the animal of choice for wet field working. Over 95% of householders surveyed have buildings for cattle and/or buffalo; the occupancy rate averages 87%. There are an average of 1.8 and 3.3 animals respectively per farm in Nghi Loc and Nam Dam districts. Animals are always housed overnight and during the day if they are to be stall-fed. Cattle and buffalo housing conditions are generally satisfactory. Penned areas average 10m² per animal; a higher unit density (8.6 m² per animal) was recorded in Nghi Loc district, where an increasing number of buffaloes have been acquired for rice crop working. All animals are kept on rice

straw bedding, which was changed as required. Manure is stacked close by within the outbuilding.

35. Cattle and buffalo are predominantly males, although the proportion of females is highest (30%) in the animal producing commune of Nam Hung. No cattle or buffalo were retained for milk production. The majority of buffalo in Nghi Loc district are replaced by stock purchased from producers in the western highlands; cattle tend to be obtained more locally, e.g. from Nam Dam district. Cattle and buffalo semen are available from the district artificial insemination service, although only two householders reported having used the service. No householder has yet had access to the improved Red Sindhi stock held at district AI centres.

36. Cattle and buffalo are grazed on marginal grass land and may have limited access to field crop residues such as sprouted rice. Untreated rice straw represents their major source of nutrients when stall-fed; they are not fed cut grasses or forage crops (Appendix 7). Livestock are fed with seasonal surpluses or the lower quality components of sweet potato tuber (dried), and cassava root (dried and unmarketable roots). These feeds tend to be available for short periods; the high use of sweet potato vines (58% of farmers use in Nam Dam) coincides with the need for supplements for grasses in the dry season. Dried cassava leaves are not used extensively. Rice bran use as cattle feed was reported by up to 20% of households. An increase in pig production will introduce an element of resource conflict with rice bran; this could be avoided by an increased use of cassava (cassava block or starch residue) as a dry season supplement.

37. At least 90% of householders surveyed have buildings for growing pigs or breeding sows. Occupancy for growing pigs averages 94%; it showed a marginal decline over the last year in Nghi Loc but had increased by 4% in Nam Dam district. There are an average of 1.5 and 2.0 growing pigs per farm in Nghi Loc and Nam Dam districts. There is a tendency to keep two pigs of differing ages to ease marketing and spread the cash return; one pig is usually grown for sale at the period of high demand around the TET (New Year) festival. Conditions in the animal facilities are generally poor, being dark, cramped and dirty reflecting the low esteem given to growing pigs. Pig management appears to be poor although it may be appropriate for a low efficiency enterprise.

38. A small number of growing pigs are local Mon Cai replacement stock but the majority are Large White (LW) x Mon Cai crossbreds. Piglets are purchased locally from producers in Nghi Van or Nam Thanh districts. The Mon Cai breed is tolerant of bad facilities and poor stockmanship;

this hardiness is reflected in the crossbred. Pure bred exotic stock have been shown not to perform well under equivalent circumstances in South Vietnam (Huynh, 1993 - personal communication).

39. Breeding sows are kept by 10 to 42% of householders, with an average facility occupancy of 95%. The majority of piglet producers have one Mon Cai (MC) sow; a second younger sow is kept on 15% of farms. Penned areas were unusually small (<4.6 m² per animal) in Nghi Loc district. Conditions were poor and were worst in facilities with youngest sows. Piglet yield per sow ranged from 75 to 189 kg per annum; piglet survival in the best district was 8.25 per litter which agrees with a 30% mortality figure from data presented by Molenat and Thong (1991) for MC sows. There are no records relating to mating interval or piglet performance. Artificial insemination for the production of crossbred progeny is used by all breeders and is available at cost (\$US 5) as a district service. Insemination is by village practitioners, which may account for the lack of advice or action on facility hygiene.

40. There appears to be little distinction between sow and growing pig rations, both in terms of quantity and composition. Rations are based on kitchen waste (estimated at least 40% DM of ration) and rice bran. Over 90% of cassava producers in Nam Dam district feed dried cassava and sweet potato to pigs, effectively incorporating root crops into the ration over much of the year. Sweet potato tuber is utilised by a lower number of householders in Nghi Loc district, reflecting their greater access to rice bran. Extensive use is made of sweet potato vines and tips; these appear to have a primary role as sources for vitamins and trace elements. No concentrate rations are used.

41. Only 20% of households reported keeping poultry for regular sale; there were no producers of eggs. Poultry share the area of the out-buildings for cattle or pigs which is used for storage. Local breeds of chicken are an indiscriminate mixture of local and improved stock which had been introduced by some districts. Little information is available on the growth potential of these poultry. Two of the householders claimed to feed poultry a concentrated ration in order to increase productivity; the majority of producers feed rice bran. Poultry for the household table scavenge the farm and consume by-products, such as broken rice and dried cassava, in addition to having access to the garden.

42. Little information is available on the quality and extent of availability of local feeds. A survey of the market in Vinh city (Appendix 11) indicated that various sources of high protein feedstuffs were seasonally available. The quality of fish meals (salted - wet season

and unsalted - dry season whole fish) is poor (Blaha and Mudrik, 1990). There are problems associated with the palatability of fish meal dried over the August to November period; these probably relate to microbial spoilage and the subsequent presence of high concentrations of protein degradation products. Prawn processing waste will be available in 1994. Farmers interviewed in this survey did not purchase any feed supplements.

43. An average of 34% of farm labour is given over to livestock (Appendix 9); the range between villages (30.2 - 41.3%) is consistent with the relative levels of crop and livestock outputs. These figures do not include the labour of children, who are used for moving cattle and buffalo to grass. Stall-held animals and pigs are fed by women three times a day; 10% of husbands feed livestock in Nam Hung district because of the relatively higher numbers of cattle on the farm.

Outputs from livestock production:

44. Farmers in Nam Dam district sell cattle for draught use after 24 months of age in what appears to be a low efficiency cattle production system. Liveweight at sale averages 140 kg (Appendix 8) with a sale price of \$US 10-12 per kg. These animals have to be fed, trained and strengthened for a further 6 - 12 months. A smaller number of buffalo are sold for draught purposes. Sales of cattle calves are made by larger producers. Farmers in other parts of Nam Dam district (not in this survey) fatten old draught cattle (8 years old - 240 kg liveweight) by 60-80 kg over a four month period using a low density rice bran and groundnut cake supplement. Over 90% of the manure produced is used 'on farm'; sales (\$US 0.02 to 0.03 per kg) are usually made to neighbours with no livestock.

45. Pig breeding productivity varies widely between communes. Sow output is highest in Nam Thanh commune, averaging 18.5 (16.5 sold plus two for fattening) piglets or the equivalent of 186 kg liveweight. Mon Cai sows would be expected to produce two litters per year, with 18 surviving to weaning or the equivalent of 225 kg of piglet liveweight. The average productivity for sows in the other three communes is 8.6 (7.1 plus 1.7 piglets held for fattening) or 100 kg of piglet liveweight per annum. Low sow productivity can be attributed to poor stock, bad facilities and poor nutrition; given that some producers may be better suited to keeping breeding sows than others. There are no records of litter size and weight. Replacement sows as gilts can be purchased from producers in these villages.

46. Weaned grower piglets are sold individually at market by women (sale price from \$US 10.0 per kg). They are fed for between 10.5 and 12 months to a sale liveweight of 90 to 110

kg. Liveweight gain over the district averaged 320 g per day; the highest daily weight gains (470 g per day) were recorded in Nam Thanh province. These farmers reported using some groundnut cake in the ration. A daily growth rate of <350 g is comparatively good given the lack of feeds, the type of stock and poor management. An average growth rate of 500 g per day should be achievable under low nutrient density rations based on dried cassava or sweet potato tuber and limited quantities of protein, from available sources such as sweet potato vines, fish meal and groundnut cake. This performance would be based on the use of exotic MC crossbreds and some improvement in key areas of pig management. Higher growth rates may be unsustainable in terms of feed (the additional protein requirement) and type of stock (veterinary support) in village based facilities.

47. Growing pigs are sold through middle-men or are marketed directly in some cases; the average sale price is \$6.5 per kg liveweight. Over 60% of the existing production are sold in Vinh city; almost 30% are sent to Hanoi direct from communes. The local market is close to saturation in view of the low purchasing power. An increase in pig production would need the existing marketing channels to Hanoi and Hue to be developed. This might impose a quality threshold in terms of the value of animals or carcasses shipped.

48. No information was collected regarding the production of poultry products; none of the farmers surveyed sold poultry products.

Comparative value of livestock:

49. The value of livestock within householder income can be calculated approximately from the questionnaire (Appendix 10). The main expenditure on livestock is stock procurement; other major identified expenses were the provision of AI and veterinary services. Expenditure on livestock represents between 21 to 30% of household expenditure; the highest expenditure, in Nam Thanh commune, averaged \$US 62.4 or 21.7 per animal unit. This expenditure reflects the purchase of additional feedstuffs. The nominal value of livestock derives from their sale, hire and as sources of manure. Farmers were unable to estimate the value of draught power and manure. Earning from draught animals may amount to \$US 30 per annum for individual farmers in Nam Hung district. The value of the sale of livestock represented between 28 and 48% of value of the farm outputs. A calculation based on sale value in relation to expenditure suggested that farmers in Nam Dam were getting twice the net unit per kg return on livestock products.

Constraints to crop and livestock productivity:

50. Farmers were asked to identify the major factors which affected crop productivity. Lack of credit was the most significant impediment to crop production. Between 59 and 63% of farmers use credit to support crop production, in order to buy seed, fertiliser and pest control services (Appendix 9). A minority of householders, particularly in Nghi Loc commune, use some credit to pay for food over the period between crops of rice. Credit is available through the Agricultural bank; the average loan was \$US 56 with interest payable at 2.5% per month.

51. Low soil fertility and lack of irrigation were consistently quoted as reasons for poor crop yield. Difficulties in drying were reported to differing degrees by all farmers. The lack of improved cultivars and crop processing were considered important in the longer term improvement in productivity. Cassava farmers claimed in this and in the previous CIAT (1991) survey that price variation and the lack of a proper marketing system were major factors which discourage increased production.

52. Livestock productivity was restricted in the first instance by lack of money with which to buy livestock and subsequently support services and feed supplements. Between 10 and 41% of farmers use credit to buy stock, dried cassava and veterinary costs. Credit usage was considerably higher (a factor of 2) in farms in Nghi Loc district. Shortage of feeding stuffs and low stock quality were also identified as important factors. Only a minority of farmers recognised that they lacked the skills and proper facilities for pig keeping.

CONCLUSIONS.

53. An increase in livestock production is possible but would require the development of existing markets outside the province.

54. Growth rates of 500-550 g per day should be readily achievable in crossbred pigs (MC x LW) using protein supplemented low nutrient density rations based on dried cassava or sweet potato meals. Both districts have limited access to various high protein feed ingredients, e.g. groundnut cake although Nghi Loc has better access to fish meal (at the coast). Both districts would be appropriate locations for comparing the effects of different quantities of protein supplements with root and tuber crop based pig rations.

55. Women sell and buy produce at market and contribute fully to the work load associated with crop production and in the feeding of animals. The introduction of improved livestock practices should be targeted at women's groups.

56. Farmers, provincial officials and staff from the national institutions were eager to participate in this farming system assessment. The interval between visits by the consultant stimulated the Provincial Agricultural Department to examine the potential of root crops and to organise the survey. There was a positive attitude by all to the use of farm trials to demonstrate new practices. Support to the extension services in training, programme management and marketing can be given by the local research institutions and the University of Hue. This should be co-ordinated through the National Roots and Tuber Programme.

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Appendix 1. Average climatic conditions at Vinh City⁽¹⁾,
Nghe An province.

Data has been averaged over 1981-1991 period.

Month	Average Temperature		Sunshine hours	No of rainy days	Rainfall mm	Relative Humidity
	Maximum oC	Minimum oC				
January	17.2	4.0(2)	72	12.1	48.8	92
February	17.2	7.3	48	12.8	41.4	93
March	20.1	9.8	64	12.9	47.8	91
April	23.9	14.0	132	9.7	58.3	90
May	27.6	14.8	213	10.4	140.7	73
June	27.1	19.7	186	7.8	131.3	73
July	29.3(3)	21.6	206	7.8	117.2	74
August	28.3	19.0	167	10.9	203.4(4)	80
September	26.6	16.7	152	14.7	544.5(4)	85
October	24.2	14.3	135	15.1	433.2(4)	89
November	21.4	5.4	95	13.1	163.5	87
December	18.8	5.4	87	10.7	75.3	91
Yearly average	23.4	12.7	-	-	-	86
Yearly total	-	-	1557	138	2010.4	-

Notes.

1. Data from meteorological station at Vinh airport.
2. Minimum recorded daily temperature was 1°C in January.
3. Maximum recorded daily temperature was 36°C in July.
4. More than 50% of rainfall was associated with tropical storms or typhoons.

Appendix 2. General details of farm householders surveyed in communes within Nghi Loc and Nam Dam districts.

District: Commune:	Nghi Loc			Nam Dam		
	Nghi Fong	Nghi Van	(Av)	Nam Thanh	Nam Hung	(Av)
1. No of households surveyed	24.0	30.0	-	20.0	26.0	-
2. Household size Average no of persons in household	5.6	5.0	5.3	5.8	6.4	6.1
3. Children						
a) No under 16 years	1.8	2.6	2.2	2.0	2.4	2.2
b) No at school	1.4	1.6	1.5	2.0	1.8	1.9
c) Attendance ratio (Note 1)	0.8	0.6	0.7	1.0	0.7	0.8
4. Occupation						
a) % main occupation as farmer	100.0	100.0	-	95.0	100.0	-
b) % households with other occupations (Note 2)	38.0	10.0	24.0	10.0	15.0	12.5
c) % households keeping livestock (Note 3)	100.0	97.0	98.5	100.0	92.0	96.0
5. Farmer house size and construction						
a) House area m ²	87.3	99.5	93.4	108.2	132.7	120.5
a) Walls index (Note 4)	2.2	1.4	1.7	1.2	1.1	1.2
b) Roof index (Note 5)	1.4	1.4	1.4	1.1	1.1	1.1
6. % of households owning						
a) Motor cycle (Note 6)	0.0	10.1	5.0	0.0	4.0	2.0
b) Bicycle	96.0	83.0	89.5	100.0	92.0	96.0
c) Radio	21.0	23.0	22.0	25.0	27.0	26.0
7. Farmed land details						
a) Ownership index (Note 7)	2.0	2.0	2.0	1.9	1.9	1.9
b) Soil type	sandy	sandy		sandy	rocky/ sandy	
c) Soil colour	silt dark brown or yellow	silt dark brown or yellow		silt yellow & grey	red brown & white grey	

Notes for measurements.

- Attendance ratio: children in education as proportion of all children aged under 16 years.
- % of households who have other income generating enterprises, e.g. buffalo hire, basketry.
- % of households keeping animals (not poultry).
- House wall construction index based on score: 1 = brick, 2 = faced block, 3 = mud framework, 4 = woven bamboo.
- Roof construction index based on score: 1 = tile, 2 = woven bamboo, 3 = thatch.
- % of households owning one or more motor cycle, bicycle or radio.
- Average index for majority land ownership based on score: 1 = private farm, 2 = co-operative, 3 = common land.

Appendix 3. Average household farm details of farmers surveyed in communes within Nghi Loc and Nam Dam districts.

	Nghi Loc			Nam Dam		
	Nghi Fong	Nghi Van	(Average)	Nam Thanh	Nam Hung	(Average)
1. Farm area m ² (Note 1)	4155.0	5501.5	4828.3	9162.5	6640.4	7901.4
2. Garden area m ² (Note 2)	919.8	805.7	862.8	915.5	1712.3	1313.9
3. Main crop area m ² (Note 3)	3980.4	5302.7	4641.6	8946.1	6375.0	7660.6
4. No of fields	6.5	7.8	7.2	12.9	8.0	10.6
5. Average field area m ²	538.0	591.7	564.9	702.7	797.4	750.1
6. Average distance between house and fields m	819.6	634.5	727.1	1125.5	990.4	1058.0
7. Rice planting						
a) Winter rice m ²	2992.9	4013.3	3503.1	3335.0	2805.0	3070.0
b) As % of planting area (Note 4)	75.2	75.7	75.5	37.3	44.0	40.7
c) Spring rice m ²	1507.5	3060.0	2283.7	3150.0	2333.9	2742.0
d) As % of planting area (Note 4)	37.9	57.7	47.8	35.2	36.6	35.9
8. Cassava planting						
a) Planted area m ²	25.0	133.0	79.0	3720.0	1884.6	2802.3
b) As % of planting area (Note 4)	0.6	2.5	1.6	41.6	29.6	
9. Sweet potato planting						
a) Planted area m ²	1220.8	1126.7	1173.8	892.5	1076.0	984.3
b) As % of planting area (Note 4)	30.7	21.2	26.0	9.9	16.8	13.4
10. % of producers using irrigation						
a) Rice		4.0	73.0	-	30.0	28.0
b) Sweet potato	4.0	67.0	-	-	-	-
c) Cassava	-	-	-	15.0	8.0	-

Notes for measurements.

1. Farm area including dwelling.
2. Garden area adjacent to dwelling.
3. Cropping fields and available garden.
4. Crop area as % of total seasonal planting area.

Appendix 4. Average major crop yields and proportion of nominal value to farmers surveyed within Nghi Loc and Nam Dam districts.

Crop	District Commune	Nghi Fong	Nghi Loc Nghi Van	(Average)	Nam Thanh	Nam Dam Nam Hung	(Average)
1. Winter rice							
a). Sown area m ²		2992.9	4013.3	3503.1	3335.0	2805.0	3070.0
b). Yield kg/ha		1225.0	3053.3	2139.9	2590.1	2338.5	2464.3
c). Annual crop weight (kg)		366.6	1225.4	796.0	863.8	655.9	759.9
d). % of total yield	(Note 1)	35.9	49.6	42.8	29.4	32.8	31.1
e). % of overall value	(Note 2)	29.2	47.4	38.3	33.8	34.6	34.2
2. Spring rice							
a). Sown area m ²		1507.5	3060.0	2283.7	3150.0	2333.9	2742.0
b). Yield kg/ha		1162.5	3196.7	2179.6	2620.0	2403.5	2511.8
c). Annual crop weight (kg)		175.2	978.2	576.7	825.3	561.0	693.1
d). % of total yield	(Note 1)	20.5	39.6	30.1	28.1	28.0	28.1
e). % of overall value	(Note 2)	16.1	37.9	27.0	32.3	29.6	30.9
3. Sweet potato							
a). Sown area m ²		1220.8	1126.7	1173.8	892.5	1076.0	984.3
b). Yield kg/ha		4670.8	4879.3	4775.1	5816.8	5960.0	5884.4
c). Annual crop weight (kg)		570.2	549.8	560.6	519.1	641.3	580.2
d). % of total yield	(Note 1)	23.4	7.8	15.6	6.2	11.2	8.7
e). % of overall value	(Note 2)	20.9	8.5	14.7	8.1	13.5	10.8
4. Cassava							
a). Sown area m ²		25.0	133.0	79.0	3720.0	1884.6	2802.3
b). Yield kg/ha		8000.0	5000.0	6500.0	7625.0	7384.6	504.8
c). Annual crop weight (kg)		20.0	66.5	43.3	2836.5	1391.7	2114.1
d). % of total yield	(Note 1)	0.8	0.9	0.9	33.7	24.4	29.1
e). % of overall value	(Note 1)	0.3	0.4	0.3	16.6	11.0	13.8
5. Groundnut							
a). Sown area m ²		858.7	521.7	690.2	950.0	807.1	878.6
b). Yield kg/ha		1234.8	959.1	1097.0	822.2	885.7	853.9
c). Annual crop weight (kg)		106.0	50.0	78.0	78.1	71.5	74.8
d). % of total yield	(Note 1)	12.4	2.0	7.2	2.7	3.6	3.1
e). % of overall value	(Note 2)	29.2	5.8	17.5	9.2	11.3	10.2
6. Major crop production per household (kg paddy)	(Note 3)	854.5	2469.3	1661.9	2941.7	1999.9	2470.8
7. Major crop production per head (kg paddy)	(Note 4)	152.6	493.5	313.6	525.3	400.0	466.2

Notes

1. % of overall yield calculated on paddy equivalent weight (see note 3).
2. Nominal value in \$US based on whole crop yield priced as; rice 1000 VND/kg; sweet potato 400 VND/kg; cassava 150 VND/kg; groundnut 3000 VND/kg. Does not include nominal income from vegetables. (1 \$US = 10,000 VND - March 1993)
3. Calculated as kg paddy equivalents - autumn rice (kg) + summer rice (kg) + groundnut (kg) + (0.35 * cassava (kg)) + (0.35 * sweet potato (kg)).
4. Population household data from Appendix 2.

Appendix 5. Fate of cassava and sweet potato crops from farmers surveyed within Nghi Loc and Nam Dam districts.

	Nghi Fong	Nghi Loc Nghi Van	(Average)	Nam Thanh	Nam Dam Nam Hung	(Average)
1. Farmers selling (% of total)						
a) Fresh sweet potato	66.0	90.0	78.0	70.0	70.0	70.0
b) Dried (stored) sweet potato	75.0	60.1	67.6	70.0	50.0	60.0
c) Sweet potato vines	70.8	83.1	77.0	-	-	-
d) Sweet potato shoots (tips)	50.0	60.1	55.0	-	-	-
e) Fresh cassava root	-	-	-	50.0	12.0	33.0
f) Dried chipped cassava	-	-	-	100.0	50.0	75.0
g) Dried cassava leaves	-	-	-	0.0	0.0	-
2. Estimated crop sold (% of total)						
a) Fresh sweet potato	44.6	59.0	51.8	62.0	65.0	63.5
b) Dried sweet potato	28.5	24.0	26.5	-	-	-
c) Fresh cassava root	-	-	-	44.0	18.0	31.0
d) Dried chipped cassava	-	-	-	46.0	72.0	59.0
3. Estimated farmer home use (% of total)						
a) Sweet potato	26.9	17.0	22.0	38.0	35.0	36.5
b) Cassava	100.0	100.0	100.0	10.0	10.0	10.0
4. Estimated dry matter household use (Note 1)						
- sweet potato (kg)	53.7	32.7	43.2	69.0	78.6	73.8
- cassava (kg)	7.0	23.3	15.1	99.3	48.7	74.0
5. Pig equivalent liveweight (Note 2)						
- sweet potato	35.4	21.6	28.5	45.6	51.8	48.7
- cassava (kg)	4.6	15.4	10.0	65.5	32.1	74.0

Note 1. Estimate from crop yield in Appendix 4 (wet weight *0.35).

Note 2. Estimate when included as 50% dry matter of ratio, 3:1 conversion.

Appendix 6. Livestock facilities, housing areas and condition data for farms surveyed within Nghi Loc and Nam Dam districts.

Measurement	Nghi Loc			Nam Dam		
	Nghi Fong	Nghi Van	(Average)	Nam Thanh	Nam Hung	(Average)
1. Livestock						
a). % households keeping animals	100.0	97.0	98.5	100.0	92.0	96.0
2. Cattle						
a). % households with facilities	87.5	27.0	57.3	75.0	54.0	64.5
b). % households keeping	70.8	20.0	45.4	65.0	54.0	59.5
c). % facility occupancy	80.9	74.1	77.5	86.7	100.0	93.4
d). Number kept per household	1.2	1.5	1.3	1.9	2.4	2.1
e). Age (months)	38.3	56.0	47.2	46.3	40.6	43.4
f). Penned area m ²	9.4	12.5	11.0	11.4	29.0	20.2
g). Area per animal	7.8	8.4	8.1	6.0	12.1	9.1
3. Buffalo						
a). % households with facilities	12.5	50.0	31.3	45.0	54.0	49.5
b). % households keeping	12.5	47.0	29.8	35.0	50.0	42.5
c). % facility occupancy	100.0	94.0	97.0	77.7	92.6	85.2
d). Number kept per household	1.0	1.5	1.2	1.2	1.6	1.4
e). Average age (months)	64.0	59.8	61.9	47.1	81.2	64.2
f). Penned area m ²	11.0	13.4	12.2	12.9	33.7	23.3
g). Area per animal	11.0	8.9	10.0	10.8	20.7	15.8
4. Breeding sows						
a). % households with facilities	16.7	13.0	14.9	10.0	42.0	26.0
b). % households keeping	12.5	13.0	12.8	10.0	42.0	26.0
c). % facility occupancy	74.9	100.0	87.4	100.0	100.0	100.0
d). Number kept per household	1.0	1.3	1.1	1.0	1.3	1.2
e). Average age (months)	18.7	32.5	25.6	38.0	28.5	33.3
f). Penned area m ²	3.3	6.0	4.7	7.5	10.0	8.8
g). Area per animal	3.3	4.6	4.0	7.5	7.7	7.6
5. Growing						
a). % households with facilities	87.5	90.0	88.8	100.0	77.0	88.5
b). % households keeping	79.2	83.0	92.2	100.0	69.0	84.5
c). % facility occupancy	90.5	92.2	91.4	100.0	89.6	91.8
d). Number kept per household	1.5	1.5	1.5	2.1	2.0	2.0
e). Average age (months)	6.3	4.8	5.4	7.0	7.0	7.0
f). Penned area m ²	5.0	5.6	5.3	7.0	7.1	7.0
g). Area per animal	3.3	3.7	3.5	3.3	3.6	3.5
6. Overall assessment						
a). Average livestock units	1.62	1.98	1.80	2.88	3.70	3.29
b). Area per livestock unit	8.69	10.88	9.79	8.88	12.59	10.74
c). Facility condition score	2.29	1.93	2.11	1.60	2.04	1.82
(Note 1)						

Note 1. Facility score ratio from objective score (1= good [space, light, clean], 2 = fair, 3 = bad [cramped, dark, filthy]).

Appendix 7. Feed ingredient use (as % farmers using) by householders surveyed in Nghi Loc and Nam Dam districts.

Form of feed	Nghi Loc			Nam Dam		
	Nghi Fong	Nghi Van	(Average)	Nam Thanh	Nam Hung	(Average)
1. Cattle and buffalo						
a). Cassava root	8.0	3.3	5.7	40.0	19.2	29.6
b). Sweet potato root	8.3	67.0	37.7	50.0	42.3	46.2
c). Cassava leaves	0.0	0.0	0.0	8.3	16.7	12.4
d). Sweet potato vines	16.7	33.0	24.9	55.0	61.5	58.3
e). Sweet potato tips	0.0	0.0	0.0	0.0	0.0	0.0
f). Rice bran	0.0	16.7	8.3	23.1	16.2	24.0
g). Rice straw	83.3	73.3	78.3	80.0	80.8	80.4
h). Kitchen waste, other	0.0	0.0	0.0	0.0	0.0	0.0
2. Sows and growing pigs						
a). Cassava root	16.7	10.0	13.4	95.0	92.3	93.7
b). Sweet potato root	41.7	23.3	32.5	90.0	92.3	91.2
c). Cassava leaves	0.0	0.0	0.0	0.0	0.0	0.0
d). Sweet potato vines	70.8	86.7	78.8	80.0	80.8	80.4
e). Sweet potato tips	41.7	86.7	64.2	75.0	75.0	75.0
f). Rice bran	75.0	90.0	82.5	80.0	84.6	82.3
g). Rice straw	4.2	3.3	3.8	0.0	15.4	7.7
h). Kitchen waste, other	79.2	93.3	86.3	95.0	92.3	93.7
3. Poultry						
a). Cassava root	0.0	0.0	0.0	20.0	0.0	10.0
b). Sweet potato root	0.0	10.0	5.0	10.0	0.0	5.0
c). Cassava leaves	0.0	0.0	0.0	0.0	0.0	0.0
d). Sweet potato vines	0.0	0.0	0.0	0.0	0.0	0.0
e). Sweet potato tips	0.0	0.0	0.0	0.0	0.0	0.0
f). Rice bran	10.0	0.0	5.0	10.0	10.0	10.0
g). Rice straw	0.0	0.0	0.0	0.0	0.0	0.0
h). Kitchen waste, other	5.0	0.0	2.5	10.0	0.0	5.0

Appendix 8. Current production of livestock on farms surveyed within Nghi Loc and Nam Dam districts.

Commune	Nghi Loc			Nam Dam		
	Nghi Fong	Nghi Van	(Average)	Nam Thanh	Nam Hung	(Average)
1. Cattle						
a) Number kept per household	1.2	1.5	1.4	1.9	2.4	2.2
b) Age (months)	38.3	56.0	47.2	46.3	40.6	43.4
c) Average sale of cattle per annum	0.0	0.0	0.0	0.1	0.3	0.2
d) Average age at sale (months)	-	-	-	24	20	22
e) Average lwt at sale (kg)	-	-	-	150.0	130.0	140.0
2. Calves						
a) Average number sold per annum	0.0	0.0	0.0	0.0	0.12	0.06
b) Average age at sale (months)	-	-	-	-	6	6
c) Average lwt at sale (kg)	-	-	-	-	65.0	65.0
3. Buffalo						
a) Number kept per household	1.0	1.5	1.2	1.2	1.2	1.2
b) Average age (months)	64.0	59.8	61.9	47.1	81.2	64.1
c) Average number sold per annum	0.0	0.0	0.0	0.05	0.04	0.05
d) Average age at sale (months)	-	-	-	24	24	24
e) Average lwt at sale (kg)	-	-	-	120.0	125.0	123.0
4. Sows						
a) Number kept per household	1.0	1.3	1.1	1.0	1.3	1.2
b) Average age (months)	18.7	32.5	25.6	38.0	28.5	33.3
5. Piglets						
a) Average number sold per annum	6.0	12.0	9.0	16.5	7.8	12.2
b) Average age at sale (months)	2.0	2.0	2.0	2.5	1.8	2.1
c) Average lwt at sale (kg)	10.0	14.0	12.0	10.0	10.7	10.3
d) Sale of piglet per year (kg)	75.0	189.0	132.0	186.0	102.7	144.4
e) Annual lwt (kg) per sow place	75.0	145.4	110.2	186.0	79.0	132.5
6. Growing pigs						
a) Number kept per household	1.5	1.5	1.5	2.1	2.0	2.1
b) Average age (months)	6.3	4.8	5.6	7.0	7.0	7.0
c) Average number sold per annum	1.5	1.6	1.6	2.1	1.8	1.9
d) Age at sale (months)	11.5	10.5	11.0	11.0	10.9	11.0
e) Lwt at sale (kg)	113.0	93.3	103.3	99.3	96.1	97.7
f) Annual liveweight sale (kg)	169.5	149.3	159.4	208.5	173.0	190.8
f) Daily lwt gain (g)	356.7	306.9	333.7	326.4	315.6	319.4
7. Annual pig + piglet lwt sold (kg)	244.5	338.3	291.4	394.5	275.7	335.1

Appendix 9. General data relating to income status of household farmers surveyed in communes within Nghi Loc and Nam Dam districts.

District Communes	Nghi Loc			Nam Dam		
	Nghi Fong	Nghi Van	(Average)	Nam Thanh	Nam Hung	(Average)
1. Growth in livestock numbers index (Note 1)	-0.25	-0.10	-0.17	+0.40	+0.38	+0.11
2. % allocation of labour						
a). To crops	58.8	67.3	63.1	69.8	67.3	68.6
b). To livestock	41.3	32.7	37.0	30.2	32.7	31.4
3. % households hiring labour	0.0	0.0	0.0	5.0	0.0	2.5
4. % credit usage by householders						
a). Crops	58.8	67.3	63.1	60.0	65.1	62.8
b). Livestock	41.2	32.7	36.9	10.0	23.7	16.9
5. Amount of credit to householders \$US						
a). Crops	50.0	13.2	31.6	22.3	19.5	20.9
b). Livestock	48.3	67.0	57.6	25.0	25.5	25.3
5. % householders with other income (Note 2)	54	23	38.5	31	32	25.5
6. Nominal household income balance \$US (Note 3)	100.2	179.2	139.7	283.6	199.2	241.4

Notes.

1. Growth in livestock numbers over previous year (+ve = 1; -ve = -1; 0 = no change).
2. of householders reporting income from other occupations and as remittances from relatives, . etc.
3. Balance of income per household based on nominal value of crops and livestock products minus identified general expenditure by household on education, co-operative tribute (rent), crops and livestock - derived in Appendix 10.

Appendix 10. Comparative value of crop and livestock products on surveyed farms within Nghi Loc and Nam Dam districts.

District Commune	Nghi Loc			Nam Dam		
	Nghi Fong	Nghi Van	(Average)	Nam Thanh	Nam Hung	(Average)
1. Nominal Expenditure						
a). Land tax	13.0	46.4	29.7	49.0	31.8	40.4
b). Education	16.0	19.4	17.7	22.5	12.1	17.3
c). Crops	28.4	75.8	52.1	75.7	44.4	60.1
d). Livestock	17.9	36.3	27.1	62.4	29.8	46.1
e). Total	75.3	178.0	126.7	209.6	118.1	163.9
f). Crops as % of total expenditure	55.0	68.7	61.9	59.5	64.5	62.0
g). Livestock as % total expenditure	23.8	20.4	21.4	29.8	25.2	27.5
h). Livestock expenditure per animal unit	11.0	18.3	14.7	21.5	8.0	14.9
2. Nominal value						
a). Crops	109.1	258.4	183.8	255.7	189.7	222.7
b). Livestock	66.4	98.7	82.6	237.5	127.6	182.6
c). Total	175.5	357.1	266.3	493.2	317.3	405.2
d). Crops as % of total income	62.2	72.4	67.3	51.8	59.8	55.8
e). Livestock as % of total income	37.8	27.6	32.7	48.2	40.2	44.2
f). Livestock value as kg output	0.27	0.29	0.28	0.60	0.46	0.53
3. Nominal household balance (Note 1)	100.2	179.2	139.7	283.6	199.2	241.4

Note 1. Calculated value; does not include earnings from other occupations.

Appendix 11. Price and availability of animal feedstuffs and fertiliser.
Data of products offered for sale from retail merchants in Vinh city.

Component	Availability	Average Price \$US per kg ⁽¹⁾	Price Variability ±
Molasses	All year	0.15	-
Groundnut cake	July - February	0.33	0.10
Maize yellow	July - December	0.17	0.01
Soya bean meal	July - December	0.55	0.10
Rice bran	All year	0.16	0.02
Rice straw	All year	0.01	-
Fish meal - low salt	March - November	0.50	0.10
- high salt	Seasonal	0.25	0.04
Shrimp meal - frozen	Not yet available	0.15	-
Shrimp head meal - dry	Seasonal	0.25	0.0
Fish sauce residue	All year	0.03	-
Cassava chips	All year	0.08	0.02
Sweet potato chips	All year	0.11	0.02
NPK fertiliser	Imported	0.50	0.0
Urea	Imported	0.07	0.0
Manure	Of farm	0.025	0.005

Notes 1. Rate of exchange; \$US = 10,000 VND

Source: Province extension service (1993).