OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

RESTRICTED 20675 MARCH 1994

PROMOTION AND DEVELOPMENT OF AGRO-RELATED METALWORKING INDUSTRIES (PHASE I)

US/RAS/92/072

WESTERN SAMOA

Country Report*

Prepared for the Government of Western Samoa by UNIDO
in co-operation with RNAM/ESCAP

Based on the work of Reynaldo M. Lantin
UNIDO Expert

United Nations Industrial Development Organization
Vienna

*This document has not been edited.

RESTRICTED

MARCH 1994

PROMOTION AND DEVELOPMENT OF AGRO-RELATED METALWORKING INDUSTRIES (PHASE I)

US/RAS/92/072

WESTERN SAMOA

Country Report*

Prepared for the Government of Western Samoa by UNIDO
in co-operation with RNAM/ESCAP

Based on the work of Reynaldo M. Lantin
UNIDO Expert

United Nations Industrial Development Organization
Vienna

*This document has not been edited.

TABLE OF CONTENTS

Page

Summary iv

List of Abbreviations xviii

List of Figures xix

Introduction 1

I. General status of the agro-related metalworking industry subsector 9

A. Public sector industry 9

B. Private sector metalworking industry 12

C. Institutional support 16

II. Status of agriculture and agricultural mechanization 22

A. Farming system 22

B. Livestock production 23

C. Currently used agricultural tools and machinery 23

D. Demand for agricultural machinery 32

E. Production of agricultural machinery 32

III. ECDC/TCDC Potentials 33

IV. Problems and constraints 34

V. Conclusions and recommendations 34

A. Agro-related machinery needed 34

B. Agricultural machinery prototypes and drawings for exchange with other LDCs 36

C. Policies and strategies 36

D. Programme for further development of the agro-related metalworking industry sector 44

VI. Project concepts 46

A. Regional Asia 46

B. Western Samoa Country Projects 58

Country project No. 1 58

Country project No. 2 75

Country project No. 3 83

References 98

Annex 99

SUMMARY

1. INTRODUCTION

The Special Programme for the Industrial Development of Asia and the Pacific, launched by the Third General Conference of UNIDO in 1979 has focused on two industrial subsectors supporting the vital agricultural sector of the least developed countries of the region: agro-related metalworking and food processing industries. This approach has been endorsed by the policy making organs of UNIDO (GC.4/Res. 8 and 9, GC.5 Res.14) and funds have been allocated from various sources in support of preparatory activities in this field. The priority areas to be addressed in the agro-related metalworking industries were identified in 1990 through a process of desk research and country consultations and a UNIDO/ESCAP Regional Workshop with representatives from most of the LDCs in the region. Subsequently a project was launched, in close cooperation with the ESCAP-executed Regional Network of Agricultural Machinery (RNAM) in Bangkok, with financial support from Italy and assisted by Associate Experts financed by Germany and the Netherlands, to achieve the following outputs by early 1992:

(a) National Focal Points in participating countries strengthened to be capable of providing a continuous flow of technical information and advice to enterprises in agro-related metalworking industries.

(b) Detailed proposals for **prototype exchanges** and assistance in the establishment of a **service for raw material procurement**, concrete **policy guidelines**, and concrete mechanisms for the **improvement of cottage-scale agro-related metalworking industries**.

(c) Detailed plan for the preparation of technical cooperation project documents in agro-related metalworking industries in areas requested by the concerned governments.

The countries participating in the process are Bangladesh, Bhutan, Cambodia, Lao PDR, Myanmar, Nepal, Solomon Islands and Western Samoa. The UNIDO expert visited all relevant production units, training and support institutions and ministries in these countries and, in addition to providing on-the-spot advisory services, prepared very detailed reports on the state of the industry in each country, constraints, potential areas of development and proposals for regional and national technical cooperation. As a result of this comprehensive analysis involving all relevant parties in the private and public sector, and bearing in mind ongoing and planned activities by the governments and the donor community in the participating countries, a thematic programme was formulated for the further promotion and development of these industries building on the successful implementation of the first phase and fruitful partnership with RNAM and the national focal points.

This Country Report on Western Samoa is one of the outputs of the UNIDO assisted Project US/RAS/92/072, Promotion and Development of

Agro-related Metalworking Industries in Least Developed Countries (Phase I). This report provides an account of the problems to be addressed, linkages with other programmes to reach the target groups, and a matrix of proposed responses by UNIDO with donor support. The overall objective of this thematic programme is to promote rural development in the least developed countries of Asia and the Pacific through the promotion of indigenous manufacturing of agricultural tools, implements and post-harvest processing equipment thus, providing a subsectoral and technical dimension to national efforts to promote and develop cottage, small- and medium-scale industries.

2. DESCRIPTION OF THE SUBSECTOR

The agro-related metalworking industry subsector in the LDCs of Asia and the Pacific region has merited due attention and priority considerations for development in view of its impact on agriculture and the rural sector communities of these countries. Since agriculture is the mainstay of the LDCs, self-sufficiency in food for the increasing population which brings pressure to the constant land area and the environment, increased productivity of land and labour and hence, of agricultural production and income of farmers, are among the primary development objectives in these countries. The development of an agro-related metalworking industry for the manufacture of hand tools, single-animal-drawn implements and small mechanical powered machinery through developing capabilities of the private sector mainly through provision of institutional support from the public sector, provides a promising growth potential in and supportive role for agriculture and the agro-based processing industries. This is in view of the past neglect resulting from a state enterprise approach in agricultural mechanization which has proven to be unsustainable especially in the socialist countries. Most of the State-owned and large-scale enterprises declined in operation and viability with the collapse of the Council for Mutual Economic Assistance (CMEA). This situation is particularly prevalent in Cambodia, Lao PDR and Myanmar.

All the LDCs have now taken the new approach of letting the private sector take over the former government function of supplying tools and implements to farmers in the current efforts of privatisation of State-owned enterprises along with the adoption of the policy from centrally planned to liberalized market economy. The private sector is therefore, expected to take the initiative and to produce the required tools and implements on a commercial basis. However, due to their lack of experience and prior success cases in the private sector, the hesitation on the part of the private sector needs to be overcome by adequate infrastructure and institutional support with less of government intervention and restrictions but with due encouragement, such as allowing their products to develop a competitive edge over imports during the early stages of the enterprise.

In most of the LDCs the village blacksmiths are the primary suppliers of basic hand tools and animal-drawn implements being used by farmers. In general however, no institutional support has been given to blacksmithing which may be classified as a metalworking cottage industry but which performs an important role in agriculture and rural development. Small-scale entrepreneurs in the LDCs have

so far been timid in investing in agro-related metalworking equipment for the production of more modern, efficient and higher capacity machines than those which can be produced by blacksmiths. Thus, the small-scale enterprises need basic machine tools in their fabrication or foundry workshops as well as technical assistance in product design, manufacturing, quality control and information on business management, including the financial and marketing aspects.

In LDCs where small-scale agro-related metalworking enterprises exist, typical owners are those who have had experience as former workers in other shops and started out to venture on their own. They simply train their own workers initially as apprentices, then given on-the-job training. Very few owners have engineering background and most workshop owners rely on their own creative and mechanical talents to produce machines which they perceive as having some market. Ideas usually come from existing prototypes or commercial machines which are copied or improved. Some medium-scale workshops may have engineers on the staff who would be assets in product development and improvement of machines being copied or adapted from sources abroad, normally as suggested or ordered by some international non-government organizations (NGO) for their projects in the country.

As the governments in the LDCs have adopted the open-market policy, any products to be marketed by the agro-related metalworking industry subsector has to compete with imported counterparts. The tariff structure, in the LDCs where it exists, often favours the imports in that finished goods are less taxed that raw materials.

In accordance with the Terms of Reference (Annex 1), the UNIDO Expert visited Western Samoa from 5 to 18 January 1994 and met with the Government officials concerned. Through the arrangements made by the Department of Agriculture, Forests and Fisheries (DAFF) and the UNDP Office in Apia,he also visited relevant institutions, organizations, factories, workshops and farming areas in Western Samoa.

This report contains two project concepts, one regional for eight least developed countries in Asia and the Pacific, including Western Samoa, and three country-specific for Western Samoa.

Based on the country reports of the UNIDO Expert for each LDC during Phase I of the project US/RAS/92/072, Promotion and Development of Agro-related Metalworking Industries in Least Developed countries, the following status of industry and the related agricultural mechanization in Western Samoa is given below

Western Samoa, like many other island countries in the South Pacific, has no developed metalworking industries comparable to those in Asian countries. Blacksmithing and foundry are non-existent. Only two metal fabrication workshops both of which are not agro-related, are found in Apia.

Except for two types of hand tools, namely the taro hole digger or "oso" and the coconut meat scraper or grater, virtually all agricultural tools and machines

are imported from New Zealand, Australia, U.K., U.S., Japan and Germany. It is notable that none is imported from any developing country, like that in Asia where the climate and soil conditions as well as the kind of crop grown are similar to those prevailing in Western Samoa and where more appropriate tools and machinery are likely to have been developed. The tools and machinery currently sold in the market have been introduced mainly on the basis of commercial decisions as there has been no institution which could have undertaken testing and evaluation of such tools and machinery. Moreover, the importation of such tools and machinery has been mainly done by a single and government-owned enterprise, the Agriculture Store Corporation (ASC) and to some extent by two other hardware stores, namely Morris Hedstrom and Bluebird. Due to a limited market and to take advantage of bulk purchase discounts, selection has been limited to a few, if not to only one design and make of tool or machinery. Thus, farmers, faced with no alternative choices, are constrained to buy whatever is offered by the corporation and the other distributors.

There is potential for blacksmithing as some of the above hand tools, like the bush knife, oso, coconut grater, hoe head, ax head, rake and trowel can be made from scrap high carbon steel such as vehicle leaf springs which are readily available. Wood charcoal and coconut charcoal could be made readily available as dead trees in the aftermath of three consecutive years of hurricanes are abundant. Coconut and cocoa production are still recovering from the devastating effects of such hurricanes which hit the country in 1990, 1991 and 1992. The taro plantations have been almost wiped out by a blight disease which started in December 1993.

Human resources in metalworking technologies are trained at the Western Samoa Polytechnic (WSP) which has satisfactory training facilities and qualified instructors in this field. The curriculum is linked with the industry through the President of the Chamber of Commerce who is a member of WSP's Board of Management.

3. CONCLUSIONS AND RECOMMENDATIONS

A. Agro-related machinery needed

New designs of handtools,particularly the bush knife,brush knife, hoe,digger, dryland weeder and rice production hand tools are needed for copying by blacksmiths, should there be training to develop them.

The following are the types of machines which are needed according to the progress of development in agriculture and the capabilities in the fabrication of agro-related machinery. Some may be procured for demonstration or trials in farmers' fields.

Agricultural hand tools

(a) Heavy duty wood knife with sheath;
(b) Curved blade bush knife;
(c) Curved blade brush knife with serrations;

(d) Sickle with serrated blade;
(e) Trowel, trough type;
(f) Trowel, flat blade type;
(g) Trowel, claw type;
(h) Taro digger, pointed and flat blades, wood handle;
(i) Hand-pushed weeder for dry land, three models;
(j) Tripod-mounted and portable coconut husker along with husking accessories;
(k) Coconut harvesting knife complete with extendible bamboo poles;
(l) Coconut meat separator, spoon type;
(m) Coconut meat scraper or grater, rotary type and
(n) Coconut harvester, sickle.

Animal-drawn implements, harness and accessories

(a) Single-ox drawn steel plough;
(b) Single-ox drawn peg-tooth harrows;
(c) Single-ox drawn inter-row cultivator;
(d) Single-ox drawn carts with steel wheels and axles, rubber tires and wooden bodies and
(e) Horse saddlebaskets.

Mechanical-powered machinery

(a) Coconut oil expeller;
(b) Oil filter press;
(c) Sugarcane crusher, manual;
(d) Cocoa grinder; and
(e) Motorized tricycle (motorcycle with side-car)

B. Agricultural Machinery prototypes and drawings for exchange with other LDCs.

There are no agricultural machines which can be exchanged by Western Samoa with other countries.

C. Policies and strategies

Institutional support programmes

(a) The need for establishing an agro-related metalworking industry

The absence of even a blacksmithing industry, for example, had caused a dependence on importation of many simple tools, like a bush knife or ax head which could otherwise have been produced locally and caused an evolution of tool designs appropriate for the conditions of Western Samoa. Among the benefits forgone include savings in foreign exchange, creation of employment, utilization of scrap metal which is abundant, lower-priced and more appropriate tools and developed

human resources in the metalworking industry to spin off other industries. In some industries, due to lack of qualified local personnel with exposure to metalworking or mechanical equipment, expatriates have to be hired or encouraged to set up their metalworking enterprises.

Basic wheeled vehicles for short movement of goods by human, animal or motorcycle power had not developed unlike in Southeast Asia. The promotion and development of small-scale agro-related metalworking industries, including agricultural hand tools, animal-drawn implements and vehicles and motorized tricycles therefore, can start off the establishment of other metalworking industries. The use of animals for draft work can even catalyze the rearing of livestock which DAFF is trying to promote. The alternative strategy is to wait until the cattle husbandry technology is adopted or has become popular.

It is therefore, recommended that DAFF, in coordination with the Department of Trade, Commerce and Industry, follow up the catalytic activities initiated during the country visit of the Consultant and, even before the start of the Phase II of the project, sustain the contacts made with the existing metalworking industries.

(b) Strategy for promoting new farming technologies, including tools and machinery

Since old habits and preferences are difficult to change in spite of obvious advantages of the new methods, a strategy is to start with the young who would not have such biases. It is recommended that a course in practical gardening simulating the recommended farming system be developed by DAFF in collaboration with the Ministry of Education for introduction to the primary and elementary school children starting with the fourth level or grade. Should the children be farmers in the future, as most of them will, they would have already been exposed to th · modern farming technologies and would be more receptive in future innovations han their parents would be.

It is further recommended that DAFF, together with the Ministry of Education, coordinate with and seek assistance of USP School to Agriculture regarding the development of the school curriculum for the school children to infuse simple but scientific and practical innovations in the elementary school education system in line with the above concept.

(c) Introduction of tools and machinery and agricultural engineering technologies

The introduction of locally manufactured tools and machinery should be integrated with that of new farming systems or be closely coordinated with the on-going WSFSP implemented by DAFF. Moreover, for a more comprehensive technology development which is aimed by WSFSP, the farming system technologies should include those on agricultural engineering, such as soil and water conservation, environmental protection, proper tillage practices, irrigation and drainage, management of water resources, farm structures as well as tools and machinery.

DAFF does not have the human resources capable of undertaking the programmes and activities which are allied to agricultural engineering.

It is recommended that DAFF coordinate with the Agricultural Engineering Section of USP School of Agriculture and USP/IRETA regarding the WSFSP and the tools and implements needed to support the farming systems activities. The close linkage with USP Agricultural Engineering Section will also catalyze the PACNATI country programmes in Western Samoa. Any relevant outputs of future programmes under Phase II of the UNIDO-assisted project on promotion and development of agro-related metalworking industries will be disseminated to the other island countries participating in PACNATI through the communications network facilities of USP which provides the secretariat services for the network.

Institutional support development

Based on the findings and observations , two options for providing institutional support for the promotion and development of the agro-related metalworking industry in Western Samoa are given below:

Option 1. This option proposes as an objective, the establishment of an agricultural engineering institutional support, not only for the agro-related metalworking enterprises yet to be established but also for the agricultural engineering technologies of which DAFF has no expertise. The institutional support will require creating a post for one agricultural engineer at DAFF and establishing a small fabrication and blacksmithing workshop at the Nafanua Agricultural Station, where a building with adequate space already exists. The workshop will be operated by three workshop technicians who will also be recruited.

Option 2. This option does away with the more formal though modest institutional support provided for in Option 1 and instead, only a coordinating officer, possibly a senior agricultural extension officer with specialization in agronomy would be assigned to follow up and coordinate the activities of the project. Since the coordinating officer will more likely have inadequate knowledge in engineering and metalworking, the required expertise will be sought from USP and WSP. The coordinating officer will have to seek assistance from USP for engineering backstopping in design and development of agricultural tools and machinery and from WSP for workshop technology, particularly in fabricating the new tools and prototypes as well as for on-the-job training of the private metalworking workers.

With suitable institutional arrangements, technical collaboration may be made by DAFF with the two institutions in design and development and fabrication of prototypes. Currently, Option 2 will be more realistic than Option 1.

Therefore, a strategy for promoting agro-related metalworking industries through institution building as provided for in Option 1 at this point of development will not be feasible nor appropriate unless the above-mentioned constraints are overcome.

Agricultural machinery and related engineering technologies

(a) Chemical weed control

Due to the favourable climate, the fertile volcanic soil and the rocky nature of the land, minimum or zero tillage has been practiced by farmers in the cultivation of taro, alocasia and vegetables. Weed control however, has always been a constraint in obtaining high yields. Weeding is a pre-occupation of farmers, particularly the women because the taro or any newly planted crop, like banana, breadfruit or tree sapling, can easily be overwhelmed by weeds which grow profusely and rapidly

The traditional practice of cutting the weeds and letting them rot on the field provides biomass and allows for a continuously fertile land. Recently, however, there is a large usage of herbicides which has caused a large demand for hand lever-operated knapsack as well as engine-powered sprayers and mist blowers. Herbicides appear to be effective for weed kills but only for three to four weeks, after which the weeds revive and spraying has to be done again.

In spite of claims by chemical manufacturers to the contrary, herbicides may still cause environmental damage to friendly insects and wildlife. A tragic outcome is that suicides among the youth in Western Samoa have been facilitated with the use of the poisonous chemicals, prompting the Government to consider banning certain weed killers with high toxicity.

Improper or careless handling and usage by farmers present a slow or cumulative poisoning hazard of which they may not be aware. This is exacerbated by the handling of water for diluting the chemicals. Rain water is commonly collected for domestic use as well as for spraying and then transported to the field where 200-litre drums are used for storage. The danger of contaminating the domestic rain water supply is always present.

The popular use of herbicides by farmers is attributed to the comparative economic advantage of chemical weeding over mechanical weeding. However, the health and environmental hazards, especially under conditions of lack of their awareness by users or farmers, should merit serious consideration by the Government. The use of herbicides or chemical weed killers and more so, of the more toxic insecticides should be controlled. Diseases due to chemical spray inhalation and skin contact with the chemicals are often insidious and the effects are not immediately discernible as they are cumulative. The seemingly harmless results in every spraying operation give a false sense of health security to the operator. Protective gear, in spite of campaigns for its use has not really been used due to the discomfort in warm climate. If the simple care and maintenance of small engines for sprayers and mist blowers could not be adequately done as evidenced by the common repair requirements with damages pointing to inadequate lubrication care, then the more complicated care of handling of chemicals would be greatly hazardous.

It is therefore, recommended that until a satisfactory handling of chemicals for weed and insect control is adopted by farmers to protect themselves and the

environment from their hazards, the use of chemicals should at least be controlled. While insecticides seem to be not as widely used as weedicides, DAFF should already introduce the concepts of integrated pest management.

(b) Mechanical weed control

A common characteristic of the noxious weeds normally infesting the fields is their ability to regrow after being cut. The farmer has to repeat the operation after about three or four weeks as cutting only rejuvenates them. Improvement of the weeding technology to bring about effective, safe, less costly and environment friendly weed control merits priority. The improvement may consist of the right method coupled with the appropriate weeding tool technology which may be promoted through an effective extension work.

The following strategies are recommended:

(i) Promote the use of a specially designed hoe, spade, digger or trowel to uproot the grass weed without or minimally breaking the root system but leaving the soil behind by shaking it off the roots. The roots gathered should not be made to make contact with the soil and should be dried but not burned to kill them. The method may be laborious but control of the weed can be permanent after two or three passes (after regrowth of missed roots) depending upon the thoroughness of the weeding operation. It is essential to prevent weed re-infestation by isolating the area, for example, by practicing the contour bunding as suggested in item 2 below. However, broadleaf types of weeds which are easier to control than the grass type may succeed the newly eradicated weed. The tool should be acceptable to the operator by making it effective, easy and increase labour productivity. Once accepted and popularized, local fabrication of the tools by blacksmiths who shall be trained may be promoted;

(ii) Promote the use of an animal-drawn or power tiller-drawn digger which will do the same function as in item (a) above but will require prior land development as described in item 2 below;

(iii) Test and promote the use of curved blade bush knife for more effective and efficient cutting of grass type weed than the currently popular straight bush knife. Improved designs of the bush knife will complement the hoe or digger which will be effective only when the top growth of weeds is cleared first. Similarly, test and promote other designs of bush knife for cutting woody stems.

(iv) Test and promote the use of a rake or a suitable claw-type design for gathering the vine type of weed for piling or composting. This vine has a weak stem and breaking it into several pieces will only assist it in multiplying itself. The effective way to eradicate it is to get the root system out with the hoe and dry it under the sun without any root part touching the soil.

(v) Test and promote the use of black polyvinyl plastic which is resistant to ultraviolet rays as mulch to prevent sunlight from penetrating the rows or

vacant spaces of the plantation and thus would eradicate the weeds without any cultivation. However, this material is an import and therefore, expensive but can be used several times unlike herbicides. Therefore, the use of black plastic can be more cost effective than that of herbicides besides incurring no health hazard. To save on plastic material, weed leaves and stems may be utilized as complement mulching material.

(vi) Promote the use of biological weed control, that is, combine the methods described in (a) to (e) above with the planting of a less noxious and shallow-rooted soil cover, like lawn grass. If adequately maintained, the new grass cover will permanently prevent the growth of the problem weeds, not compete for soil nutrients with the deep-rooted crop, like taro and provide a soil "bioskin" to prevent erosion. Then, combine further with raising of sheep which would eat or trim the said grass but not the crop.

(c) Soil conservation tillage farming system

(i) Contour farming

Apart from preventing soil erosion, the contour rock bund will check weed growth or reinfestation in the cultivated contour strips. Moreover, it will protect the cropped area against loose animals, a deterrent to planting backyard vegetables where fences have to be built.

With these technologies appropriate tools and machinery will be needed. For example, to make rock bunds along the contour lines, a rock picker and wheelbarrow will be needed as the hand-picking method is perhaps too tedious, laborious and discouraging for the Samoan farmer.to do.
Such land development can be slow, especially if the land pressure is not yet being felt as it is at present.

(ii) Sloping agricultural land technology (SALT)

This technology is similar to contour farming. Hedgerows of perennial plants which may be harvested for forage are planted along contours. They provide a barrier to soil erosion. Tools needed for this is the forage harvester which may consist of a curve knife and then a forage cutter. Composted biomass assures the return of nutrients to the soil.

(d) Animal-drawn implements and carts

This is a technology yet to be introduced. However, it requires the development of animal husbandry which DAFF plans to promote. A successful introduction of cattle rearing will encourage training the animals to pull loads.

It is recommended that an assistance programme for livestock production be initiated by FAO with a view to utilizing the animals also for draft work.

(e) Coconut harvesting

Harvesting of coconuts every 45 days and coinciding with their maturity stage when their oil content is at its peak is highly advantageous although it requires the practice of a new method. Instead of the current method of gathering nuts which have naturally fallen and therefore, are way past their maturity stage for optimum oil content, the coconuts will be gathered from the tree top using a coconut harvesting knife attached to a light extendible pole. If such a tool were made available and the harvesting system introduced, production of oil could be increased even without increasing the current coconut yields. This tool and harvesting technology which is well-developed in the Philippines and other coconut-producing countries can be transferred to Western Samoa. The harvesting tool can be locally made by blacksmithing which is yet to be introduced.

It is recommended that the coconut harvesting knife be one of the tools which should be introduced to Western Samoa. Along with it, is the blacksmithing technology and the harvesting system which involves gathering, husking and field transport.

(f) Rural transport

There is virtually no indigenous transport facility in the rural areas. Farmers and villagers have to depend upon hired or borrowed motor vehicles, like pick-up trucks owned by relatives or private ones for hire, which can be inconvenient and time-consuming to arrange. Moreover, field-to-road transport is not normally served unless there are farm roads.

Animal-drawn vehicles would require training farmers in animal rearing for pulling loads as well as developing capabilities in the country for fabricating carts. Such capabilities will also lead to use of animal-drawn implements.

Another possible rural transport is the motorized tricycle which can be assembled by small-scale metalworking shops when given training on actual machines to copy. Such vehicles are versatile and can be used for personnel as well as for transport of produce up to a payload of 300 kg.

It is recommended that a programme for building carts be initiated in places where cattle rearing has taken place. The strategy is to encourage village craftsmen to build wooden cart bodies onto steel wheel and axle kits fabricated and assembled by small-scale metalworkshop enterprises from scrap motor vehicle parts. When the full-scale animal husbandry technology has been adopted by farmers, use of animal-drawn carts will likely be adopted. On the other hand, if some farmers who already practice cattle rearing also utilize animal-drawn carts and implements, the demonstration effect will induce other farmers to rear cattle for the same purpose.

It is further recommended that a programme to introduce the fabrication and assembly of motorized tricycles be initiated by popularizing the use of the vehicle and providing technical assistance to interested metalworkshops in fabricating and

assembling tricycles using motorcycles as power units. Designs could be obtained from Asian countries where tricycles are popularly used for short-distance trips either for passenger or for light hauling services.

(g) Blacksmithing

Blacksmithing is an unknown art and technology among the Samoans. Even the basic hand tools used for farming and gardening are imported. Developing a blacksmithing industry in the villages will provide advantages of convenience of tool procurement especially those who have limited access to transportation to the city or provincial capital. Moreover, tools can be made according to the specifications of the farmer-user, especially women, and will therefore increase productivity. Raw materials can be procured by the blacksmiths themselves from the town or by those who seek the blacksmith's services.

With proper training in design and heat treatment technology, blacksmiths can produce improved tools adapted from designs commonly used by farmers in Asia whose working conditions are similar to those of Western Samoa.

It is therefore, recommended that blacksmithing technology be introduced by DAFF and external technical assistance for training of trainers and provision of catalytic equipment be sought. A pilot and demonstration blacksmithing shop or smithy may be established at WSP.

D. Programme for further development of the agro-related metalworking industry sector.

The need for establishing an agro-related metalworking industry

The infancy status, if not lack of a viable metalworking industry in Western Samoa, had cost the country in foregoing several development opportunities. The absence of even a blacksmithing industry, for example, had caused dependence on importation of many simple tools, like a bush knife which could otherwise have been produced locally and caused an evolution of tool designs appropriate for the conditions of Western Samoa. Among the benefits would include savings in foreign exchange, creation of employment, utilization of scrap metal which was abundant, lower-priced tools and developed human resources in the metalworking industry to spin off other industries. In some industries, due to lack of qualified local personnel with exposure to metalworking or mechanical equipment, expatriates have to be hired. Basic wheeled vehicles for short movement of goods by human or animal power had not developed unlike in Southeast Asia. The promotion and development of agro-related metalworking industry therefore, could start off the establishment of other metalworking industries.

It is therefore, recommended that DAFF in coordination with the Department of Trade, Commerce and Industry, follow up the catalytic activities initiated during the country visit of the consultant and to sustain the contacts with the interested party concerned even before the start of the Phase II of the project.

Introduction of tools and machinery

The introduction of locally manufactured tools and machinery should be integrated with that of new farming systems on be closely coordinated with the on-going WSFSP implemented by DAFF. Moreover, for comprehensive technology development as is the aim of WSFSP, the farming system technologies should include those on agricultural engineering, such as soil and water conservation, environmental protection, proper tillage practices, irrigation and drainage, management of water resources, farm structures as well as tools and machinery to implement such technologies. DAFF does not have the human resources to undertake the above consideration.

It is recommended that DAFF coordinate with USP Agricultural Engineering regarding sustained assistance in this regard, until such time that agricultural engineering capabilities at DAFF are developed.

Extent of development of the agro-related metalworking industry

The promotion and development of the agro-related metalworking industry need not be wide, as the size of the country is small and the demand for tools and machinery would be limited due to the small population. Unlike other South Pacific island countries, Western Samoa's resources are concentrated in just two major islands which is only a one-hour trip apart by ferry boat. Access to the island of Upolu which contains about two-thirds of the total population is easy.

It is therefore, recommended that the promotion and development of the small-scale agro-related metalworking industry be focussed initially at Upolu island and expand to the more sparsely populated Savaii island according to the pace of development of commercial agriculture.

Agricultural engineers for DAFF staff

It is essential that DAFF have a staff agricultural engineer to take care of the engineering requirements for agricultural development. Some of the areas of concern are soil and water conservation engineering, watershed development, agricultural mechanization systems for the transition from subsistence to commercial farming, agricultural machinery development, environmental protection, post-harvest technology and processing and others. Education and training may be obtained at USP or in any developed agricultural universities in Asia.

Development of engineers for industry

Engineers are needed as technical support staff of DAFF. Education for new engineers may be obtained from established educational institutions in Asia or in the neighbouring countries of Western Samoa where mechanical engineering degree courses are offered.

Compared with other South Pacific Island countries, Western Samoa consists of only two main and five other small islands which are closely grouped together and

are therefore, easily accessible from one another. The islands are volcanic and highly erodible. The landscape is rock-strewn making it difficult for application of modern farming technologies, such as furrow or rotary tillage culture.

Along with the thrust of the government to have the inhabitants graduate from subsistence to commercial farming, there is a need to institute a soil conservation tillage farming system before any furrow cultivation gets popularized. The traditional practice of point planting and tree farming, notably coconuts and cocoa, appears to be ecologically sound and any intervention may bring about irreversible soil degradation problems.

Modernizing the farming technology may be as simple as the use of animal-draft power which will need also the introduction or teaching of livestock production by animal rearing rather than ranch method as is the normal practice. Apart from the little pressure being felt on land use, the cultural barrier must be overcome as the Samoans have had no experience in handling large animals. In some places, however, horses are being used for transport. The slow adoption of the technology may be a blessing as a too fast one may tend to ignore the prerequisite adoption of soil conservation tillage farming system to avoid environmental problems.

Blacksmithing is still an unknown technology among most Samoans. If introduced for adoption by Samoans, the blacksmithing industry could supply the agricultural hand tools such as bush knives, spades, trowels and axes that are normally imported. It could be an avenue for the development of better tools and implements appropriate to the farming conditions in Western Samoa.

The only tools being fabricated locally are the taro digging bar, locally called the oso which is a simple pointed metal rod used for spot planting the taro seedpieces or tree seedlings. The other tool is the coconut scraper. These are being made by two metalworking enterprises, which apart from them Western Samoan does not have any agro-related metalworking industry.

Transport of commodities from the farm to the road is done by manually carrying them on the shoulders. Sometimes horses are used. Although pick-up trucks owned by those with relatives working abroad can be rented for marketing of products, the costs are high. A simple transport system in the rural areas, like the motorized tricycles which are common in Asia, can make the transport of both commodities and personnel easier and faster.

The development of the agro-related metalworking industries in Western Samoa needs to start from the basics.

LIST OF ABBREVIATIONS

AIDAB	Australian International Development Assistance Bureau
ASC	Agriculture Store Corporation
CTA	Technical Centre for Agriculture and Rural Co-operation
DAFF	Department of Agriculture, Forests and Fisheries
DBWS	Development Bank of Western Samoa
ECDC	Economic Co-operation Among Developing Countries
ESCAP	Economic and Social Commission for Asia and the Pacific
IDF	Industrial Development Fund
IRETA	Institute for Research, Extension and Training in Agriculture
NAS	Nafanua Agricultural Station
NFP	National Focal Point
PACNATI	Pacific Network for Agricultural Tools and Implements
RNAM	Regional Network for Agricultural Machinery
TCDC	Technical Co-operation Among Developing Countries
UNDP	United Nations Development Programme
UNIDO	United Nation Industrial Development Organization
USP	University of the South Pacific
WS	Western Samoa
WSFSP	Western Samoa Farming Systems Project
WSP	Western Samoa Polytechnic
WSTEC	Western Samoa Trusteeship Estate Corporation

LIST OF FIGURES

Figure 1. Scenic landscape but rocky soil in Western Samoa. Top: Verdant pasture; Bottom: Volcanic but rocky soil. Unless, the field is meticulously cleared of rocks, furrow or rotary tillage will be difficult.

Figure 2. Typical country residential houses with open sides. Most thatched roofs have been replaced by corrugated galvanized iron roofing sheets. Note the rocks on the front yards.

Figure 3. The serious weed problem. Top: Taro plantation overwhelmed by weeds; remarkably the plants appear healthy and less afflicted by blight disease unlike those in the field below where chemical weeders have been used. Could it be that the heavy use of herbicides induced the blight disease?

Figure 4. A well cared for taro plantation spared from blight disease due to use of recommended measures such as sanitation and spraying with fungicides. Note that no herbicide has been used.

Figure 5. Display of mostly imported hand tools and machinery being sold at the Agriculture Store Corporation. Top: Hand tools; Bottom: Engine-powered machinery, like hand tractor, chainsaws, brush cutters and sprayers; near the chainsaws are locally fabricated digging bars or osos and oso points in two boxes.

Figure 6. Left: Some of the workshop equipment for sheet metalworking and structure fabrication by the LCC Brown Enterprise. Shown are the Deputy Director of the Department of Agriculture, Forestry and Fisheries (centre) and the workshop owner (right) during a visit. Right: A manually operated hollow-block making machine fabricated by the workshop. Three units of the machine have been fabricated on order basis.

Figure 7. Children carrying coconuts and other farm products on the shoulders.

Figure 8. The entrance to the University of the South Pacific.

Figure 9. Commercial machines obtained by the University of the South Pacific for possible adaptation in design. Left: Root crop chipper; Right: Vegetable seeder.

Figure 10. Machines fabricated at the Agricultural Engineering Section of the University of the South Pacific. Top: Manually operated and lever type peanut sheller; Bottom: Solar drier.

Figure 11. Training workshop facilities at the Western Samoa Polytechnic. Top: Machining section; Bottom: Welding section.

Figure 12. Top: Cattle ranching under coconut trees; Bottom: Saddleless horse but helps children in their transport chores.

Figure 13. Set of tools used by a progressive farmers' workers. Top: Left to right: two picks, one banana desuckering tool, push-pull weeder, hand trowel in foreground, hoe, shovel four sizes of digging bars (osos) and knapsack sprayer; Bottom: Close up of the push-pull weeder blade and the banana desuckering tool.

Figure 14. The idle copra drier at the plantation of the Western Samoa Trusteeship Estate Corporation. Top: Rear view of the drier showing the furnace leading towards the heating chamber; the box-like structure on top of the heating chamber contains the drying trays. Bottom: Inside the heating chamber looking towards the furnace from where the brick-lined pipe conveys the heated air through an oil-drum pipe which turns around and discharges the smoke and flue gases at the smaller diameter hole at the upper right portion of the concrete wall (seen on the left side at top picture);

Figure 15. Drying chamber where trays containing coconut meat are placed on shelves.

Figure 16. Small farm holder' s copra drier where smoke contacts the coconut meat being dried. Top: The rock-walled heating chamber on top of which the coconut meat is spread on wood slats; Bottom: Inside the heating chamber, coconut shells are lined up in domino fashion for continuous burning.

Figure 17. Cocoa drier. Top: Rear or chimney end of the drier showing the drying tray on top of the heating chamber (wood pieces have come from the collapsed drier shed); the chimney pipe connects to a 15-cm diameter pipe hidden by the small mound of rocks for insulation; Bottom: Inside view of the heating chamber looking towards the furnace end located outside the heating chamber; the 50-cm diameter mild steel pipe which acts as the heat exchanger exits directly at the constricted chimney end.

INTRODUCTION

Geography and population

Western Samoa comprises two main islands, Upolu and Savaii, and seven small islands in the Central South Pacific. The total land area is about 2,934 square kilometres. The economic zone is about 130,000 square kilometres.

The people of Western Samoa are Polynesians and the population is about 160,000 of whom about 34,000 live in Apia, the capital and the only city. The rest of the population live in about 330 villages. The population growth of 0.6% per year has been mitigated by a substantial net outward migration of about 1.7 % of the population per year since 1984. There are an estimated 100,000 Samoans living in New Zealand, Australia and the United States, including American Samoa. This emigration of workers, mainly males and 20 to 30 years old, has resulted in the shortage of labour and brain drain. However, their actual remittances back to relatives with whom they still maintain strong family and cultural ties are estimated to be substantially higher than the US$40 million recorded in 1992. These remittances, in cash and kind are also significantly higher than the combined receipts from exports and foreign aid combined.

Most Samoans live by means of subsistence activities and combined with the extended family network and government social services, their basic needs are generally met. The basic health services, like immunization of children are good in spite of the few doctors, some of whom are expatriates with specialization. Infant mortality is low. Most children receive nine years of primary education and at least three years of secondary education. There is a very high percentage of adult literacy.

Brief history

The first notable "agents of change" were the missionaries who, in the 1830s converted Samoans into Christianity. Staring in the 1840s, Germany, the United State and Great Britain extended their influence on the island groups to develop and protect their own commercial interests. In the 1880s, the rivalry among the largest factions intensified and the Samoans turned to foreign powers for support. A naval battle in 1889 was only averted by a hurricane which wrecked six of the seven ships. By an elaborate agreement in Berlin, Samoa became an neutral state ruled by three nations.

In 1889, a civil war threatened after the death of a key figure in maintaining peace but was again averted with the signing of an new convention whereby Germany would administer the islands west of 171 degrees longitude and the United States was to administer what is now Western Samoa. In 1919, New Zealand occupied Western Samoa and in 1949 was mandated by the then League of Nations to administer the country. In January 1962, Western Samoa became the first South Pacific Island nation to attain independence.

The country has a legislative assembly of 47 elected members of parliament. Only holders of "matai" titles which are customary titles based mostly on land and kinship, can vote to select the 45 seats in parliament. The other two seats are elected by popular vote. The Prime Minister and eight ministers comprising the cabinet are appointed from parliament.

The people and society

The social unit of Samoan life is the "aiga" or extended family which is headed by at least one matai who is appointed by consensus of the aiga. The matai assumes responsibility for directing the use of land and other assets belonging to the aiga. Local authority is also in the hands of the matais who constitute the council of the village which is presided over by the village mayor, a position appointed by the Government on recommendation of the council and usually rotated within a group of influential matais. The use of customary land comprising about 82% of the land holdings and 80% of agricultural production is in the hands of the matais. Under the present legal system, only the matais can lease land. This exclusive right is a recognized constraint it agricultural development and certain measures are being made to enable non-matai tittle holders to also lease land.

The Samoan way of life or "Fa'a Samoa" is rooted in this social organization. It places great importance on the dignity and achievements of the group rather than the individual members.

The economy

The economy of Western Samoa is dominated by village-based agriculture, Remittances from family members working overseas and external aid. Western Samoa is no longer a society of largely self-sufficient units. Imported food and other items, including tools and appliances, are now established as basic household necessities. The Government recognizes that there is an urgent need to improve agricultural performance in order to pay for these imports.

Recently however, the traditional exports, coconut and cocoa, have been virtually nil because of the destructive effects of the cyclones which hit the country in 1990 and 1991. The production of taro, a staple and partly exported also mainly to New Zealand to cater to the resident Samoans there, is also virtually zero because the leaf blight disease, an epidemic which started in late 1993. Bananas which recently emerged as an exportabie commodity is about the only major source of export earnings. Remittances from relatives living in New Zealand and Australia have been reduced due to economic recession in the two countries. Other sources are tourism which has also gone down, some industrial products like beer, cigarettes and more recently, automotive wire harness from a Japanese-Australian subsidiary company and foreign aid.

Unless a destructive cyclone hits the country (critical season is December to March), the coconut and cocoa industries are expected to recover. Anticipating a coconut production recovery, a private consortium of Samoan and American investors

leased the government-owned Samoa Coconut Products Limited at the Vaitale Industrial Estate. The coconut oil milling plant has been idle since 1990 due to the damage of the first cyclone.

Employment at the private sector as of December 1991 was 12,600 or two-thirds of the work force. An increase in employment of about 31% over the previous year was attributed to the automotive harness assembly factory whose products are exported to New Zealand and Australia. The company employed about 1,500 Samoans or 11% of the total private sector employment be the end of 1992.

Emigration of skilled labour has been a concern. The government has reinstated the service bond which requires those sent for study abroad under fellowship programmes to return. Coupled with tighter immigration policies and recession in New Zealand and Australia, the outflow of population is expected to be curtailed and more Samoans would be expected to return. However, there has not been a visible programme, like the promotion of small and medium-scale industries where returnees could be absorbed either in the public or private sector employment.

The Government has incurred large current account deficits in 1991 and 1992 mainly due to large government expenditures for rehabilitation which rose from 22% of GDP in 1989 to 31% in 1990. Expenditures have remained at such high level and perhaps increased because of another cyclone in 1991.

Minimum wage was at WS$1.25 (about US$0.375) per hour. Because of the escalation in Government expenditures for salaries and wages which totalled 46% of the current expenditure or 11.5% of GDP in 1992, it initiated reductions in overall size of the civil service and would now base future general salary increases on the rate of inflation. These initiatives are to affect any proposals for institution building to support activities.

Agriculture

Agriculture is the mainstay of the economy, accounting for 40 percent of GDP. The major cash crops are coconut, banana and cocoa. Taro, a staple crop and used to be exported, has been virtually wiped out by the blight disease since December 1993. Banana and breadfruit have became major staples. Another destructive cyclone may cause food shortage. Western Samoa may have to import rice. Due to the rolling terrain and the loose, rocky and volcanic soil, wetland rice culture is not suitable. However, upland or dryland rice can be grown on account of the favourable soil and climate.

The land is generally strewn with volcanic rocks and boulders making it difficult to use tractors or power tillers. Figure 1 and Figure 2 show the rolling landscape and the generally luxuriant vegetation in spite of the rocky conditions of the land.

Figure 1. Scenic landscape but rocky soil in Western Samoa. Top: Verdant pasture; Bottom: Volcanic but rocky soil. Unless, the field is meticulously cleared of rocks, furrow or rotary tillage will be difficult.

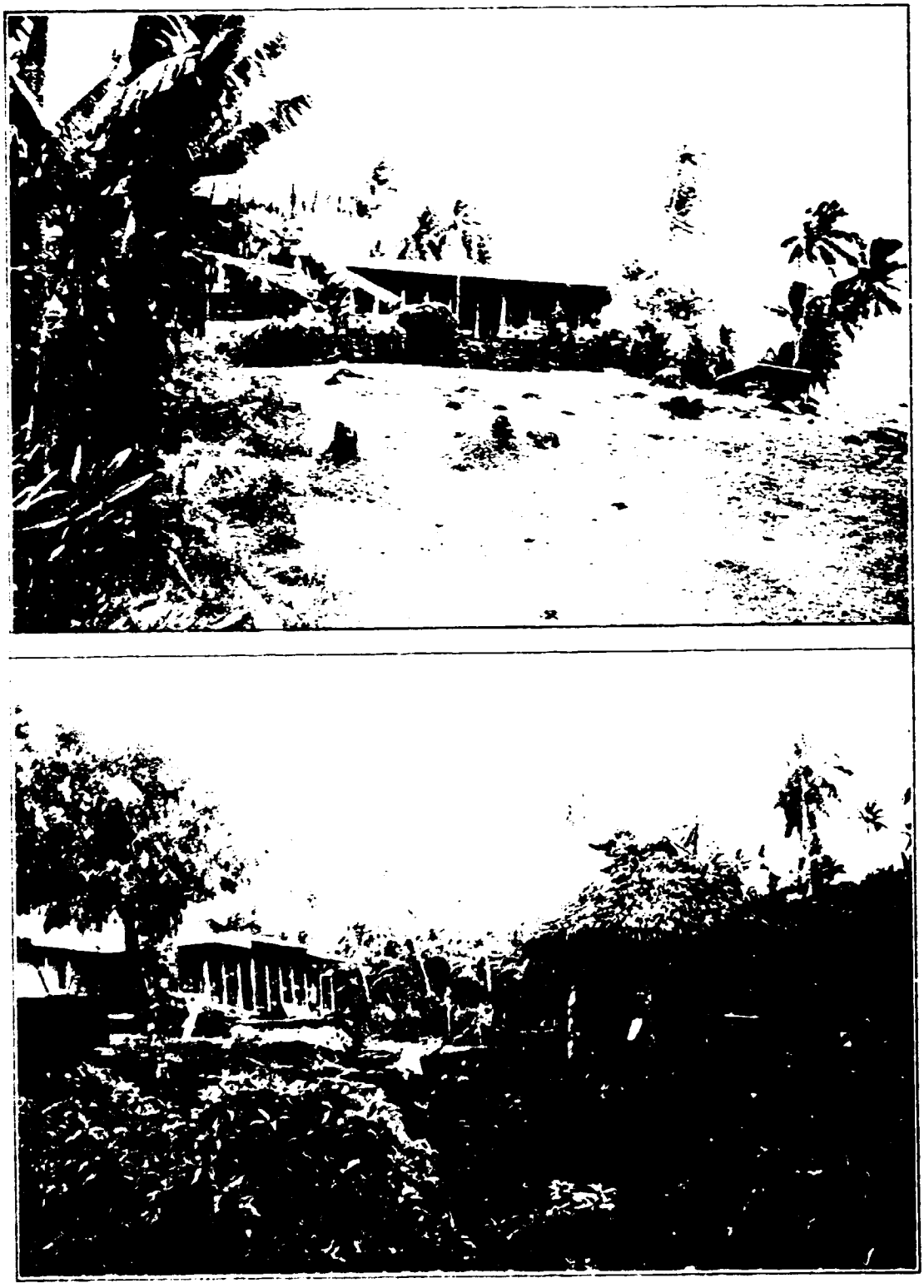

Figure 2. Typical country residential houses with open sides. Most thatched roofs have been replaced by corrugated galvanized iron roofing sheets. Note the rocks on the front yards.

The soil is thin and erosion can easily occur if the wrong tillage or cultivation technique is used. The traditional minimum tillage using the oso is somehow ecologically appropriate since the soil has an almost constant plant (and weed) cover as well as sporadic rock protection. No line or furrow tillage is done.

Trees, like coconuts, bananas and breadfruit which are spot planted by making individual holes similar to taro planting, are the predominant crops. Other crops, like cucumber, gourd, pineapple and some vegetables, are being planted in small patches of land but also by depositing individual seeds or seedpieces rather than cultivating the area to be planted. However the planted area is first cleared of weeds using the hoe or the bush knife.

Aside from the rocks, weeds are a major problem (Figure 3). The fertile volcanic soil and the favourable climatic conditions promote the lush growth of a type of grass which has invaded most fields. As a result, engine-powered grass cutters are commonly used by those who can afford the machine. An alternative to mechanical weeding is the use herbicide which gives only temporary relief from weeds like what brush cutting does. After two to three weeks, new shoots will again sprout and in two more weeks the area would be back to same status as before it was cut or sprayed with chemicals. The effective way to permanently eliminate the weed in a farm is to take all the root system out and dry it, a job which is tedious and time-consuming and not attractive to the common Samoan farmer, probably because there was no proper tool to do it.

Cyclone Ofa hit Western Samoa in February 1990 and Cyclone Val, the most destructive in 100 years, hit it in December 1991. As a result of these natural calamities export earnings based on coconut, cocoa and taro dropped to zero. An infrastructure rehabilitation programme, a priority after cyclone Val, resulted in the current smooth-paved roads not only those in Apia but also those leading to major villages in the more populated island of Upolu. Farmers are able to bring their produce of cash crops consisting of bananas, pineapple, coconut, breadfruit and papaya to market using pick-up, trucks and public buses. There are no other means of transport as animal-drawn carts, pedal or motorcycle-powered tricycles were non-existent. Some farmers use the horse for farm to house transport. There are no saddles nor other contraption to ease the burden or to increase the load carrying capacity of the animal. Otherwise, small loads contained in two woven coconut leaf baskets which are balanced on a pole across one shoulder is the common means of moving goods.

While Taro is a devastated crop, it will likely be revived once the leaf blight epidemic, caused by a fungus, is controlled. A few progressive farmers who followed the recommended clean culture, that is removing the leaf lesions as they became noticeable and spraying high dosages of fungicides, are able to control the disease as shown in Figure 4. They are expected to make a windfall for their taro harvests later. Sale of the main tool for taro planting, a pointed iron rod, called "oso", has gone to zero. The oso is a pointed metal round bar used for jabbing the soil to make a hole for depositing the taro seedpiece by hand and covering it by foot.

Figure 3. The serious weed problem. Taro plantation (top) overwhelmed by weeds but the taro plants appear healthy and less afflicted by blight disease unlike those in the field (below) where chemical weeders have been used. Could it be that the heavy use of herbicides induced the blight disease because of an ecological unbalanced caused?

Figure 4. A well-cared for taro plantation spared from blight disease due to use of recommended measures, such as phyto-sanitation and spraying with fungicides. Note that no herbicides have been used.

To establish a system of row-crop cultivation and yet be environment friendly, farm land development is necessary. In such land development, rocks must be removed or set aside in one area to clear the planting area. The system must consider, however, that the soil is thin and that the islands have a fragile ecology. The soil is highly erodible and without plant cover, a heavy rain will wash away a large amount of soil.

One proven method to avoid or minimize soil erosion is strip cropping or alley farming following the contour levels of the land. Introducing the system will need patient and considerable effort in extension work plus the supply of tools or teaching the farmers how to make them especially those for laying out contour lines and transporting rocks. For these tasks a tool support system, which might include the A-frame for marking contour points, rakes or forks for collecting rocks and wheelbarrows for transporting them to contour lines, would have to be included in the extension work activities and made available commercially. Harder still, is convincing the generally conservative farmers to adopt the new technology. Alternative technologies must consider retaining the ecologically sound features of the traditional system, that is, maintaining a plant (including weeds) cover on the soil to minimize erosion. Failure of such alternative technology to conserve the soil will be disastrous to the ability of the land resources to sustain food production.

Improved technologies in agriculture are also needed to be introduced to obtain higher productivity levels. For example, systematic harvesting of coconuts rather than using traditional method of collecting naturally fallen nuts would minimize losses and increase oil or cream production. The traditional practice of gathering fallen coconuts leads to processing the coconut at an over-mature stage where the oil or cream content will have already diminished. However, harvesting the nuts from the tree rather than collecting them after they will have naturally been detached from the fruit stem will need the appropriate tools which must be introduced along with the new harvesting technology. Again this will need serious, patient and considerable efforts in agricultural extension and blacksmithing as a tool-making industry to provide support.

The introduction of a new farming system or a new crop, will need a new set of tools or improvements of those traditionally used by farmers. DAFF has started implementing the Western Samoa Farming Systems Project (WSFSP), with assistance from the Australian International Development Assistance Bureau (AIDAB). Among its six components are human resources development in extension and introduction of new crops. However, the tool system for the introduction of such crops is not a focus although it will be needed. Pending development of a tool-making support industry, the supply of tools will come from imports. It will be advantageous for the project on promotion and development of agro-related metalworking industry, Phase II to link with WSFSP. Initial efforts have been made regarding this through the NFP.

I. GENERAL STATUS OF THE AGRO-RELATED METALWORKING INDUSTRY SUBSECTOR

Western Samoa, like many other island countries in the South Pacific, has no developed metalworking industries comparable to those in Asian countries. Blacksmith and foundry shops are non-existent. Only two metal fabrication workshops, both of which are not agro-related, can be found in Apia.

There is virtually no agro-related metalworking industry. Only two types of tools, a coconut scraper or grater and a steel bar hole-digger/jabber, called oso, used for spot planting taro and sometimes trees, are locally fabricated. All other tools, such as bush knives, hoes, axes, trowels and spades as well as engine-powered machinery, including chainsaws, misters and grass cutters, are imported mostly from U.K., U. S., Australia, New Zealand, Japan and Germany.

A. Public sector industry

The following describes the profile of the only public sector enterprise dealing specifically on the importation and sales of tools and machinery for agriculture. Its role in the metalworking industry is that it becomes the marketing arm of the two types of locally fabricated tools.

The Agriculture Store Corporation

The importation and sale of tools and agricultural machinery together with other inputs, like fertilizers, agricultural chemicals and seeds are mainly undertaken by the Agriculture Store Corporation (ASC), a trading company operated under DAFF. Figure 5 shows some of the hand tools and some engine-powered machinery being sold at ASC.

While the concept of the ASC is sound, as it provides most agricultural inputs regularly and at reasonable prices, it hinders initiatives in the private sector to engage in similar trading or even local manufacture. For example it competes at an advantage, two hardware stores selling axes and bushknives.

ASC however, responds o the developments in the local supply of tools. For example, it no longer imports coconut scrapers or graters and digging bars or osos and sells only the locally produced ones at much lower prices than before. In this regard, ASC plays an important role in promoting new and locally made tools and machinery and can change the developed desire of Samoans for things imported to things which are locally made provided the latter has the quality, appropriateness and price which are comparatively advantageous to the farmer or user. It may be concluded that preference for the imported commodities is the result of the lack of choice in the market.

ASC, in the eyes of development planners, must generate income or be at least self-liquidating. In its role as pioneer in introducing new tools and machinery, it has encountered problems of large inventory of non-moving items or stock. It has no promotion arm or activities, like demonstrations or studies of actual field requirements and appropriateness of the machines to field conditions. For example, it has imported five small four-wheeled tractors of which only two have been sold after a storage period of three years. It has also sold only three out of seven power tillers it imported in 1991. Unless the power tiller is demonstrated either by the DAFF extension unit or by the first buyers, as in the case of engine-powered grass cutters or chainsaws, tractors and power tillers will not get popularized. Perhaps, they are not appropriate at all not only in terms of the high prices but also in terms of suitability of any row cultivator or rotary tools to the rocky soil conditions in Western Samoa.

The transport of commodities from farm to market is done by motor vehicles, the most common of which is the pick-up truck. Aside from these, there are no other vehicles for the purpose as even motor tricycles, animal-drawn carts, pedal-driven tricycles, push-carts and rickshaws which are common in Asian developing countries are non-existent in Western Samoa.

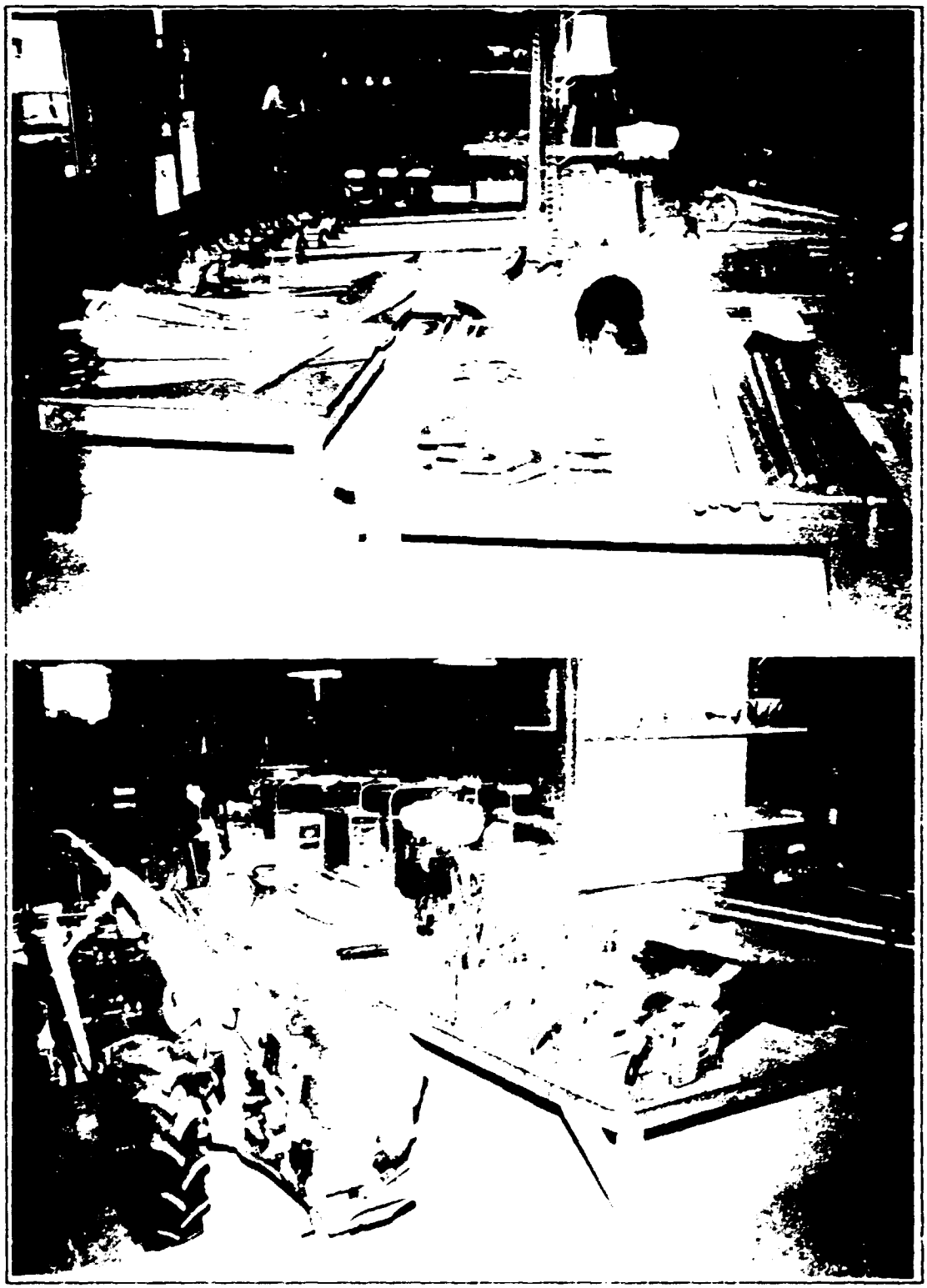

Figure 5. Display of mostly imported hand tools amd machinery being sold at the Agriculture Store Corporation. Top: Hand tools; Bottom: Engine-powered machinery consisting of hand tractor, chainsaws, brush cutters and sprayers; behind the chainsaws on the table are locally fabricated digging bars or osos and oso points (in the boxes).

The ownership of the pick-up truck prestigious as it gives an impression of successful farming. Actually, most of the acquisition of such facility is made possible by remittances from relatives abroad rather than by the farm income. About the only example of a commercially operated agricultural enterprise which can justify ownership of a pick-up truck is that one scientifically managed taro plantation. Because of technology inputs, the plantation has been spared from the blight disease and with the price of taro in the domestic and export market having gone up several fold, the income from one hectare of taro plantation could be sizable. The surviving patches of taro, obviously owned by the richer and more progressive matais, will not give the owner a large income but also prestige as a successful farmer. Such prestige points are held dear in the Samoan society and could be an entry point on motivating farmers to adopt new technologies.

B. Private sector metalworking industry

There is no metalworking industry specializing in agro-related machinery. The few ones whose profiles are described below could be utilized as starting points for local fabrication of agricultural machinery designs which may be introduced on the country. However, such machines would at first be done by job orders at a relatively higher cost, but would give the workshop an experience in doing so. Thus, if the machine becomes popular, or known to farmers through extension work by DAFF, fabrication services would be available.

A workshop to be established especially for agro-related metalworking would have to start at a small scale enterprise and as a general one which would engage in various kinds of fabrication work, such as for construction, water tanks and other devices. It will take time and effort to develop the workshop to a degree comparable to a progressive one in Asia as workers have to be trained and technical assistance would be necessary. The following are brief profiles of the existing metal workshops in Apia.

The Brugger Industries (Samoa) Ltd.

This metalworking workshop is 20% owned by the Government and 80% by the New Zealand company. It employs 12 local workers and is headed by a New Zealander. Its primary business activity is fabrication of structural forms for building construction, water tanks and to little extent, automotive mufflers. It has plans and is ready to undertake construction of single hull aluminium boats, a departure from the traditional Samoan double-hulled boats. Before the taro blight epidemic, Brugger Industries used to fabricate osos with machined conical points. The outlet was the ASC.

The raw materials and workshop equipment used by the workshop are imported mostly from New Zealand. The workshop would be interested in fabricating agricultural machinery if the designs were available. In comparison with single large fabrication job orders in the construction industry, the profit margin for smaller and supposedly cheaper agricultural machinery items is much lower and therefore, such job orders would have less priority and even higher costs than

normally would be. This is because of high overhead costs coupled with the longer learning time needed to fabricate machinery with moving elements. While it may be prepared to accept job orders on a case to case basis, it could not be expected to do any machinery development work with testing activities. If required by the government to do limited development activities, the costs would be passed on to the government share of the company.

The LCC Brown Enterprise

This workshop was established in 1991 by a mechanical engineering graduate from a New Zealand university and has engineering work experience in that country. The main activity of the workshop is the fabrication of light steel structural components to support his own construction contracting business which employs 35 persons. Figure 6 shows the workshop.

The workshop specializes in sheet metal working and the array of workshop equipment is geared for only that purpose. It once built three units of concrete hollow block making machine and for his lathe work requirements for fitting shafts to bearings, he had to contract the job to a technician graduate of WSP who acquired a small lathe to start a small jobbing business.

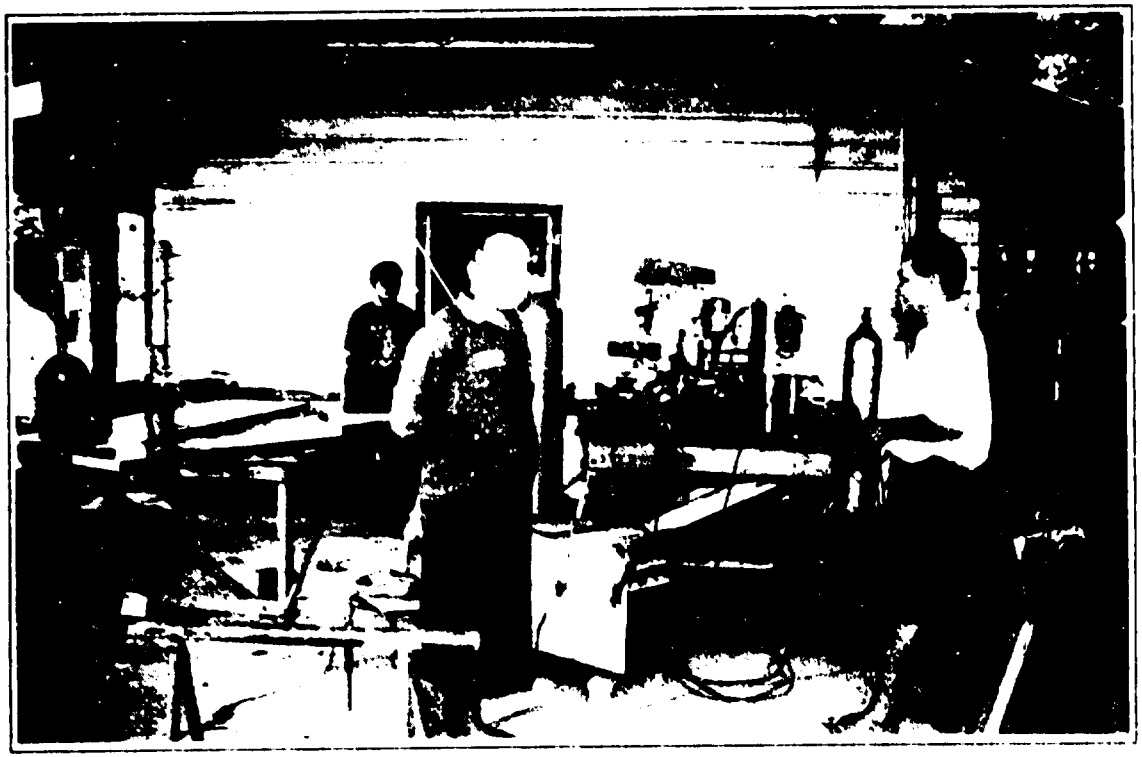

Figure 6. Left: Some of the workshop equipment for sheet metalworking and structure fabrication by the LCC Brown Enterprise. Shown are the Deputy Director of the Department of Agriculture, Forestry and Fisheries (centre) and the workshop owner (right) during a visit. Right: A manually operated hollow-block making machine fabricated by the workshop. Three units of the machine have been fabricated on order basis.

In general, the workshop appeared to be progressive and being one of the few metalworkshops in Western Samoa, it is always fully loaded with job orders. It is capable of fabricating agricultural machinery if given design drawings and better yet, sample prototypes. However, it needs a lathe machine which the owner intends to acquire according to his expansion plans.

The Samoa Coconut Oil Production Ltd.

This coconut oil mill which utilizes copra as raw material has a workshop mainly for doing repair and maintenance services for the oil milling machinery. However, its manager plans to utilize it also for fabrication purposes. He plans expand the workshop facilities, to accommodate outside fabrication job orders and to engage in the manufacture of agro-related machinery, including small transport vehicles such as pedal-drive and motor tricycles.

The reason for such interest is to assist coconut gatherers who comprise mostly women and school children transport the nuts to copra makers. With better transport facilities, they would be eased of their carrying burden and their transporting capacity would be increased. Thus, they will increase their income and much more, the women especially, would get cash income directly instead of through their husbands who rarely give them a fair share of the proceeds. Figure 7 shows children carrying loads on their shoulders.

Figure 7. Children carrying coconuts and other farm products on shoulders.

The workshop intends to fabricate pedal and motor tricycles, push-carts and wheelbarrows. In the long term, after cattle rearing and training of animals for draft purposes have been adopted by villagers, animal-drawn carts will be fabricated. Designs of these equipment may be obtained in most countries in Asia.

The manager of the company also plans to establish a blacksmithing facility for making different designs of bush knives, brush knives, sickles, hoes, trowels ,axes and hand weeders to compete with the imported ones. He also intends to make coconut harvesting and primary processing tools, like the pole sickle, coconut husker, coconut knife, coconut grater or scraper and coconut shell charcoal maker. At a later stage and as capabilities of workshop workers develop, the workshop may fabricate simple agricultural machinery, like peanut threshers, shellers and roasters as peanut growing gets popular due to the good results from those who pioneered in planting the crop.

The Agricultural Engineering Shop

This is a repair workshop for small engine-powered machinery, particularly brush cutters, chainsaws, mist blowers and lawn mowers. The usual component needing repairs is the engine and a common damage or breakdown is the stuck piston due to insufficient lubrication. Such nature of engine damage indicates lack of knowledge in maintenance procedures.

The workshop is a 10 x 15 metre room attached to the ASC sales building. It was originally operated by ASC itself until it was leased in mid-1993 to the present operator who was ASC's former employee. There are two repair assistants and the job orders continue as a stream.

The operator of the shop wants to expand his operations towards fabrication of simple tools which are imported and sold by ASC. However, he would need training in blacksmithing and in fabrication work in spite of his vocational training background at WSP. His six-month training in Japan dealt with engine repair.

C. Institutional support

There are two institutions which could supply the trained human resources to initiate or engage in activities for the agro-related metalworking industries. One of such institutions, the University of the South Pacific, is regional and entry of Samoans is quite limited because of the high costs. However, fellowships could be made available from sponsors. The other institution, the Western Samoa Polytechnic, is vocational and offers technical courses in metalworking.

The University of the South Pacific (USP)

The Alafua campus of USP in Western Samoa has a School of Agriculture has an agricultural engineering section which handles courses in agricultural machinery and mechanization which are however, are limited in scope to selection and general knowledge of mechanization. Figure 8 shows the campus gate.

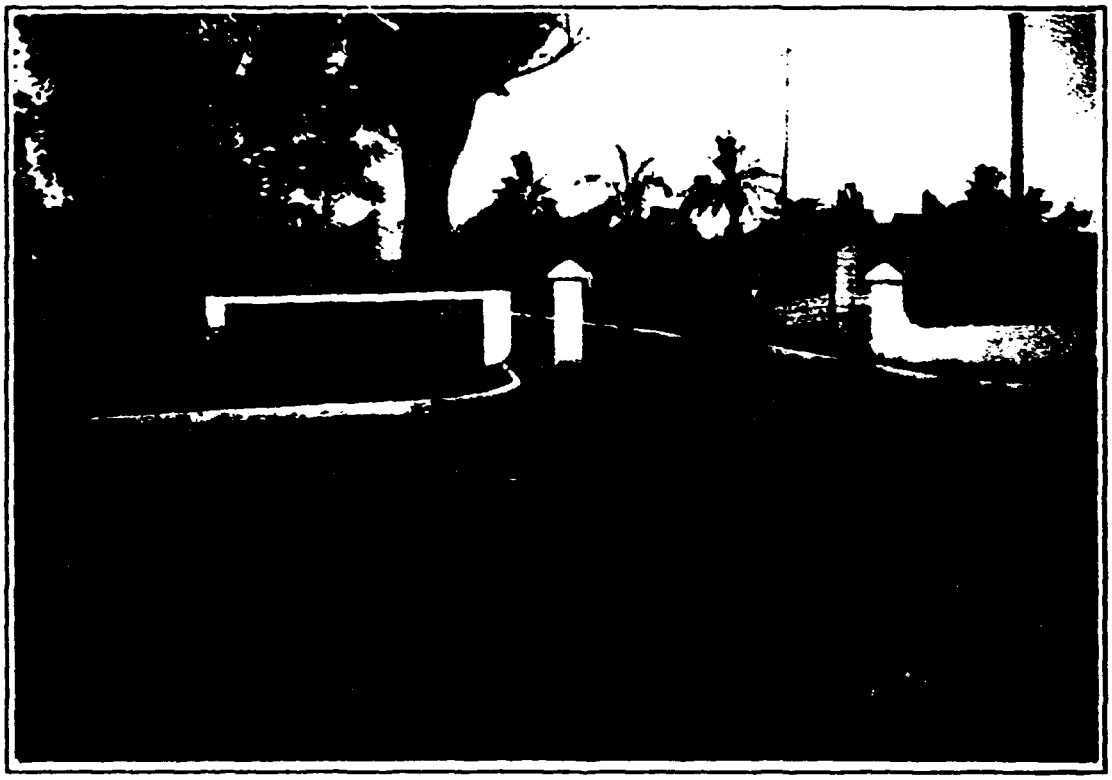

Figure 8. The entrance to the University of the South Pacific at Alafua, Western Samoa.

The agriculture department of USP is divided into six teaching discipline sections, namely, agricultural economics, agricultural engineering, education and extension, animal science, basic science and crop science. It has also the Institute for Research, Extension and Training in Agriculture (IRETA). Among the facilities are two farms, Alafua/Moamoa and Laloanea which are shared with IRETA for research purposes.

The School's programmes related to the agro-related metalworking industry are the Master of Agriculture, Post-graduate Diploma in Agriculture, Bachelor of Agriculture and Diploma in Tropical Agriculture.

The Agricultural Engineering Section has a workshop for teaching basic agricultural engineering courses, farm workshop practice and farm structures. Exposure of the students to farm machinery and mechanization is limited to basic workshop practices and selection, operation and maintenance of basic farm implements. No courses are offered in machinery design or one which would prepare the graduate to engage professionally in agricultural tools and machinery design and fabrication.

The Diploma in Tropical Agriculture is a practical course which aims to prepare students for employment in agricultural and educational services, allied agricultural industries and private agricultural enterprises. A diploma graduate would be qualified to assist in agricultural extension services and yet would have practical

knowledge in agricultural tool and machinery fabrication, operation and maintenance. Such dual skills in both agriculture and industry would be an asset in the promotion and development of agro-related metalworking industry.

The staff in agricultural engineering consists of a senior agricultural engineer, a graduate assistant and a workshop supervisor/instructor. Another agricultural engineer is being recruited. Together with the Director of Farms who has practical agricultural engineering experience, the staff of the Agricultural Engineering Section could provide, under special collaborating arrangements with the Department of Agriculture, Forests and Fisheries (DAFF), technical backstopping in the design, testing and modification of agro-related machinery prototypes which might be introduced through an industry development programme.

The Agricultural Engineering Section has a collection of machinery prototypes some of which have been fabricated at its workshop while others have been procured from other developing countries. Some of the commercial machines are the AIT jab seeder from Thailand, the root crop chipper from India and the vegetable seeder from the U. S. Some of the fabricated machines are the lever-operated peanut sheller and a cabinet type solar drier. Some of these machines are shown in Figure 9 and Figure 10.

While the machines have been useful for the academic training purposes of the USP School of Agriculture, their practical value to local agriculture has not been exploited as there is no extension programme in this regard. A collaboration programme with DAFF would be mutually beneficial. The agricultural engineering courses will have more practical and useful meaning. They will catalyze the establishment of small-scale agro-related metalworking industries, not only in Western Samoa but also in other South Pacific island countries.

The USP/IRETA hosted the FAO Regional Expert Consultation on Agricultural Implements and Tools of the South Pacific Islands during the period 21-24 September 1992. The staff of agricultural engineering was actively involved in its organization and in the conduct of the Consultation.

Following the recommendation of the Consultation, the USP School of Agriculture has agreed to provide secretariat services to the Pacific Network for Agricultural Tools and Implements (PACNATI). The Agricultural Engineering Section has been pursuing the formation of PACNATI through the FAO offices in the Pacific countries.

Figure 9. Commercial machines obtained by the University of the South Pacific for possible adaptation in design. Left: Root crop chipper; Right: Vegetable seeder.

Figure 10. Machines fabricated at the Agricultural Engineering Section of the University of the South Pacific. Left: Cabinet-type solar dryer; Right: Manually operated peanut sheller.

The Western Samoa Polytechnic (WSP)

This institution offers vocational training at levels of basic certificate (one-year course), intermediate trade certificate (two-year course) and full certificate of craftsmanship (4.5-year course). The basic certificate programme mainly consists of theory and practice of fitting, turning and welding. The intermediate trade certificate programme provides the student with practical mechanics skills and exposure to project work, industrial experience, trade process, communication skills and material science as well as develops support skills, like engineering drawing, mathematics and library processes. The full certificate of craftsmanship programme includes three years of full-time attendance at WSP and one and one-half years of industrial experience.

The facilities of WSP are reasonably adequate, the institution having been assisted by external aid programmes (Figure 11). Instructors are well qualified and some have been trained abroad. However, most of them have no industry experience. This lack tends to make the approach to teaching too academic to give enrichment to the student's knowledge of the industry requirements in real life. The students' exposure to industry is limited to technical knowledge as there are no courses or subjects in their curriculum to prepare them for self-employment.

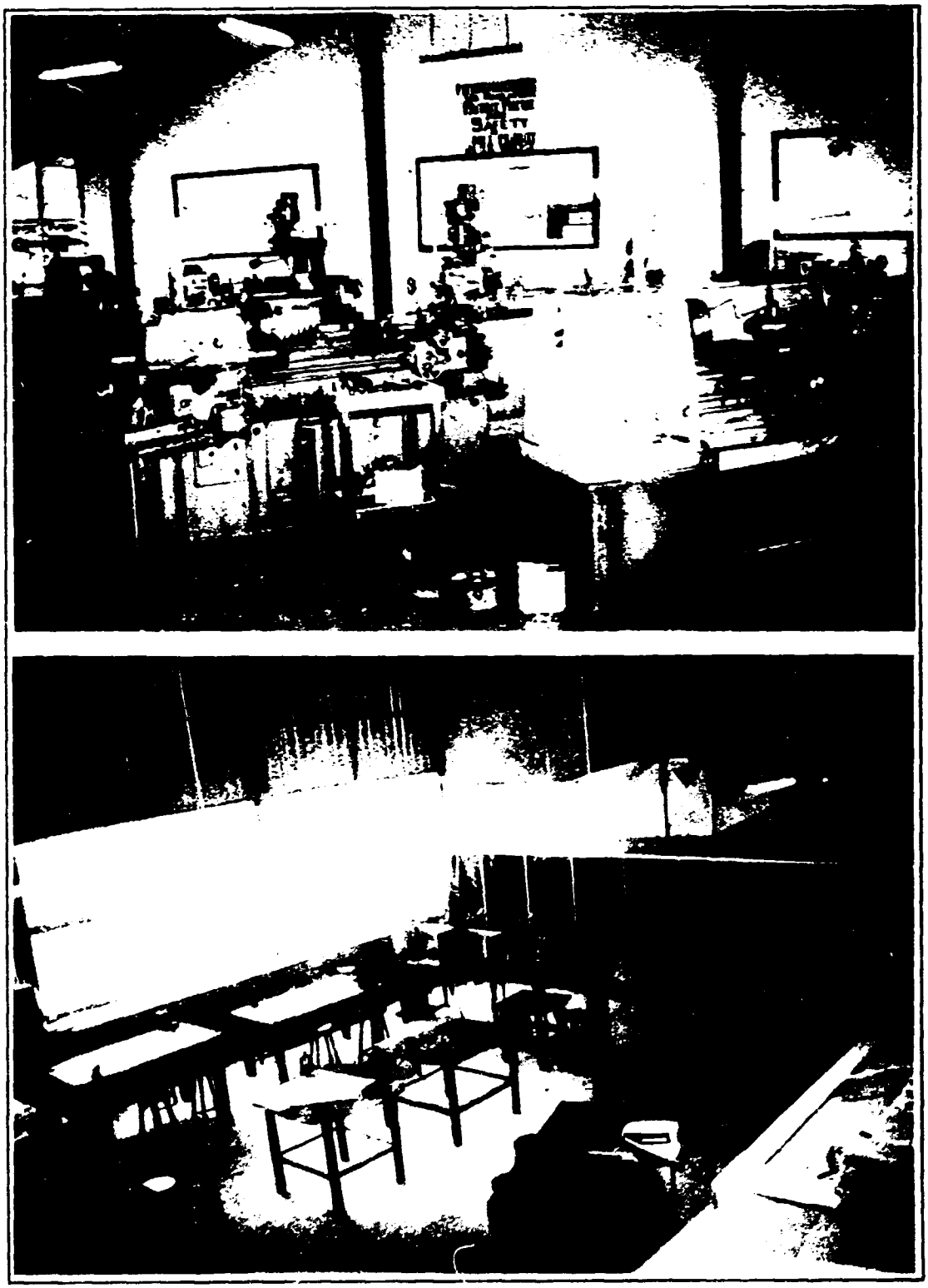

Figure 11. Training workshop facilities at the Western Samoa Polytechnic. Top: Machining section; Bottom: Welding section.

WSP has institutional linkages with the private industries through a representative each from the Chamber of Commerce and the Western Samoa Manufacturers' Association in the six-member Board of Directors.

WSP may be tapped to help the private industries in the fabrication techniques of new machines which may be introduced by a future project through DAFF. The involvement of the instructors themselves in real-life activities of the industry would have enriching effects in their instruction and yet fill the gap , even temporarily, in fabrication skill requirements of small-scale metalworking industries especially in the production of initial units of agricultural machinery.

II. STATUS OF AGRICULTURE AND AGRICULTURAL MECHANIZATION

The development of agriculture determines the demand for tools and agricultural machinery as well as the small-scale processing equipment for certain types of crops. Agriculture is slowly moving away from subsistence farming and the people are getting aware of the need for commercial agriculture if only in a small way. Annex 2 gives some agricultural statistics relevant to the development and promotion of the agro-related metalworking industry in Western Samoa.

Recently, the people of Western Samoa suffered some set-backs, as follows:

(a) The slow-down in remittances from relatives abroad;

(b) The destruction of crops and infrastructures by two cyclones which hit the country in February 1990 and December 1991 cutting down the main exports of coconut products (copra and cream) and cocoa and

(c) The taro blight epidemic which started in late 1993 and virtually wiped out all plantations except the few where the recommended spraying and meticulous care and plant sanitation are practiced.

The destruction of taro, the country's staple food has resulted in the people switching to banana aside from the usual breadfruit which is seasonal. It has put pressure on the population to produce more food and derive more income from agriculture and from fishing.

A. Farming system

Agriculture is traditionally at subsistence level. There is need to improve the farming system towards commercial farming. One of such improvements is in the area of tool supply which needs to be integrated with any development efforts in the farming system.

Although the market for agricultural tools and machinery is small, there is a need to develop the local metalworking industry to supply the needed mechanical inputs. DAFF has realized that the lack of indigenous tool-making industry is holding back agricultural development. Such a need has not been seriously considered because of lack of technical assistance in this regard. Much of the knowledge gained by the

staff of DAFF from their own exposure to technologies abroad could not be applied to agriculture because of the lack of tools and machinery. The types of tools presented in the market are only those that will satisfy the requirements of traditional agriculture. DAFF is considering integrating the tool system in the farming systems project to have a more comprehensive approach in introducing new types of economic and cash crops.

If furrow tillage and cultivation by use of animals or rotary tilling operation by the use of power tillers or tractors is to be done, land development is necessary. Efforts must be made to collect the rocks and pile them in rows along the contours to serve as fence and prevent soil erosion. That would be a demonstration of how improved agricultural technology, in this case, strip cropping along contours could make possible the use of modern tools and even create a demand for machines normally used in the more developed countries. Thus, the role of DAFF in the promotion and development of the tool and machinery industry as well as the application of agricultural engineering principles are needed.

Cultivable land is plentiful but most are idle grasslands in coconut plantations. Some of these grasslands are ideal for pasture. The customary land tenure system is constantly blamed for the underdeveloped agriculture although such consolidated ownership makes it easier for commercial farming, unlike in the fragmented land ownership in most countries in Asia. Know-how in agricultural technology and management of commercial farming however, must exist in the aiga. There is a need for training of some members of the aiga who may be tasked to manage the aiga's property for commercial farming according to an arrangement with the co-owners and, of course, the matai.

B. Livestock production

Cattle is usually raised in pastures and not reared in backyards as commonly practiced by small farmers in Asia. If animal draft power is to be promoted in Western Samoa, the Samoans must first learn the techniques of cattle rearing. Horses however, are being reared and used for field transport. Figure 12 shows a ranch type animal rearing and the use of the horse for transport purposes.

Promoting cattle rearing may encounter cultural barriers as it has never been a part of the Samoan way of life. The younger generation may be the target of such introduction.

C. Currently used agricultural tools and machinery

Each crop production and processing system uses tools and machinery which may either be common with other crops or specialized for the crop depending upon the operation and the level of technology used. Figure 13 shows a set of hand tools used by the more progressive farmers. The ordinary farmer will only have the basic bush knife, hoe, spade, and oso.

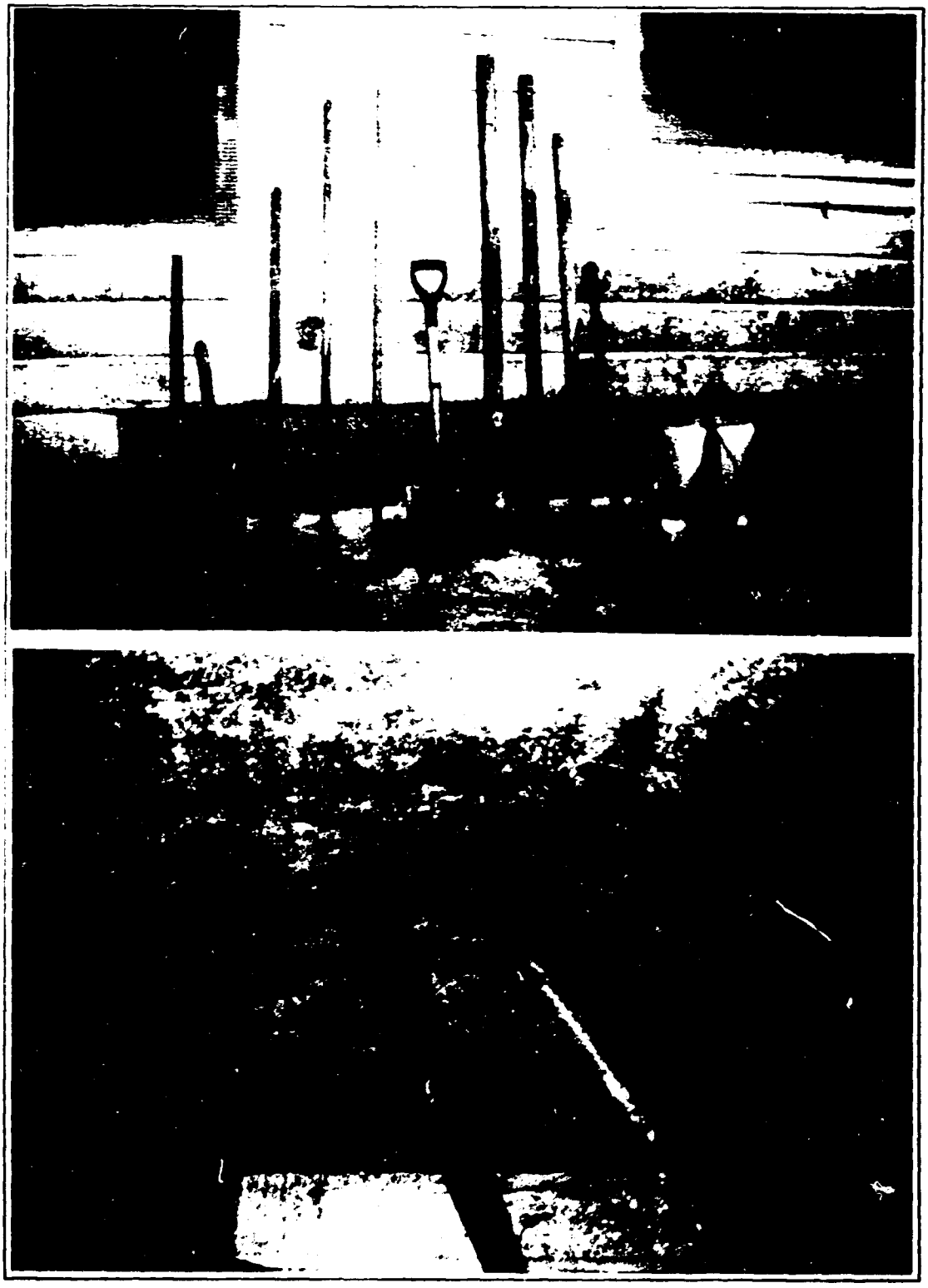

Figure 13. Set of tools used by a progressive farmer's workers. Top: (Left to right): Two picks, one banana desuckering tool, push-pull weeder, hand trowel (foreground), shovel, four sizes of digging bars (osos) and knapsack sprayer mainly for weedicide. Bottom: Close up views of push and pull blade and the banana desuckering tool.

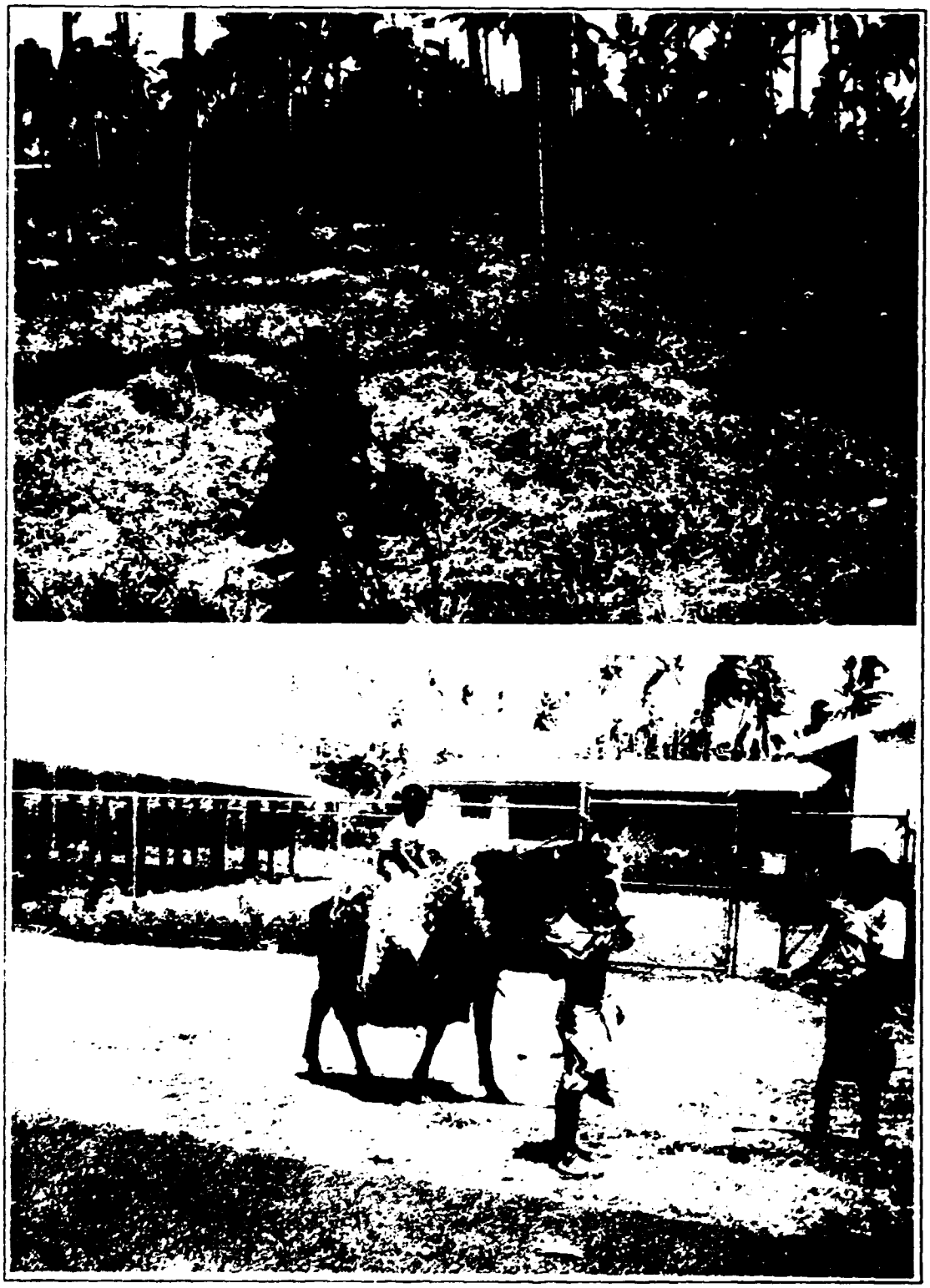

Figure 12. Top: Cattle ranching under coconut trees; Bottom: Saddleless horse but helps children in their transport chores.

The following describes the types of tools used for producing or processing each major crop in Western Samoa:

(a) Taro. The popular tool is called oso or digging stick. It consists of a bar usually made of 2-inch (50-mm) galvanized iron pipe with welded conical points at the ends. Others consist of mild steel rod with pointed ends made by pounding then sharpening. The demand for this tool has gone down since December 1993 due to the collapse of the taro cultivation resulting from the leaf blight epidemic.

(b) Coconut. Planting of this crop is occasional and occurs only when there is need for replanting. The oso and the hoe are common planting tools.

In harvesting, naturally fallen, rather than deliberately gathered nuts are collected and transported by human labour using a carrying pole or narrow and flat bamboo slat across the shoulder. No other means of transport, except for the horse which is sometimes used.

The coconut husker, usually a pointed stick or iron bar stuck into the ground, is used for removing the outer covering or husk. A bush knife is usually used for breaking the coconut shell and a special coconut knife is used for removing the meat from the shell if the meat is to be dried for copra-making.

The drier consists of a rectangular and rock-walled chamber heated by a furnace through a 40-60 cm diameter pipe made of mild steel. The exit of the pipe constricts to a 25 cm chimney thus retaining as much heat in the tunnel as possible. the furnace at the mouth of the pipe is fired by coconut shells or firewood. Wood slats on top of the chamber contain the coconut meat to be dried. No smoke comes in contact with the coconut meat while it is being dried.

The principle used in the above design had been used also in the large scale drying of coconut meat by the Western Samoa Trusteeship Estate Corporation (WSTEC), a public-owned company which has ceased copra-making operations and is engaged only in selling of coconuts from its plantation. The drier had been idle and neglected for more than five years.

However, the drying technique used is basically sound. The coconut meat which are placed in wire mesh-bottomed trays does not have any contact with the smoke or combustion products from the wood- or coconut shell-fired furnace. Hence, the copra produced is a clean product. Figure 14 shows the dilapidated drier building and some of the design features of the furnace and the heating chamber. Figure 15 shows the drying cabinet located above the heating chamber.

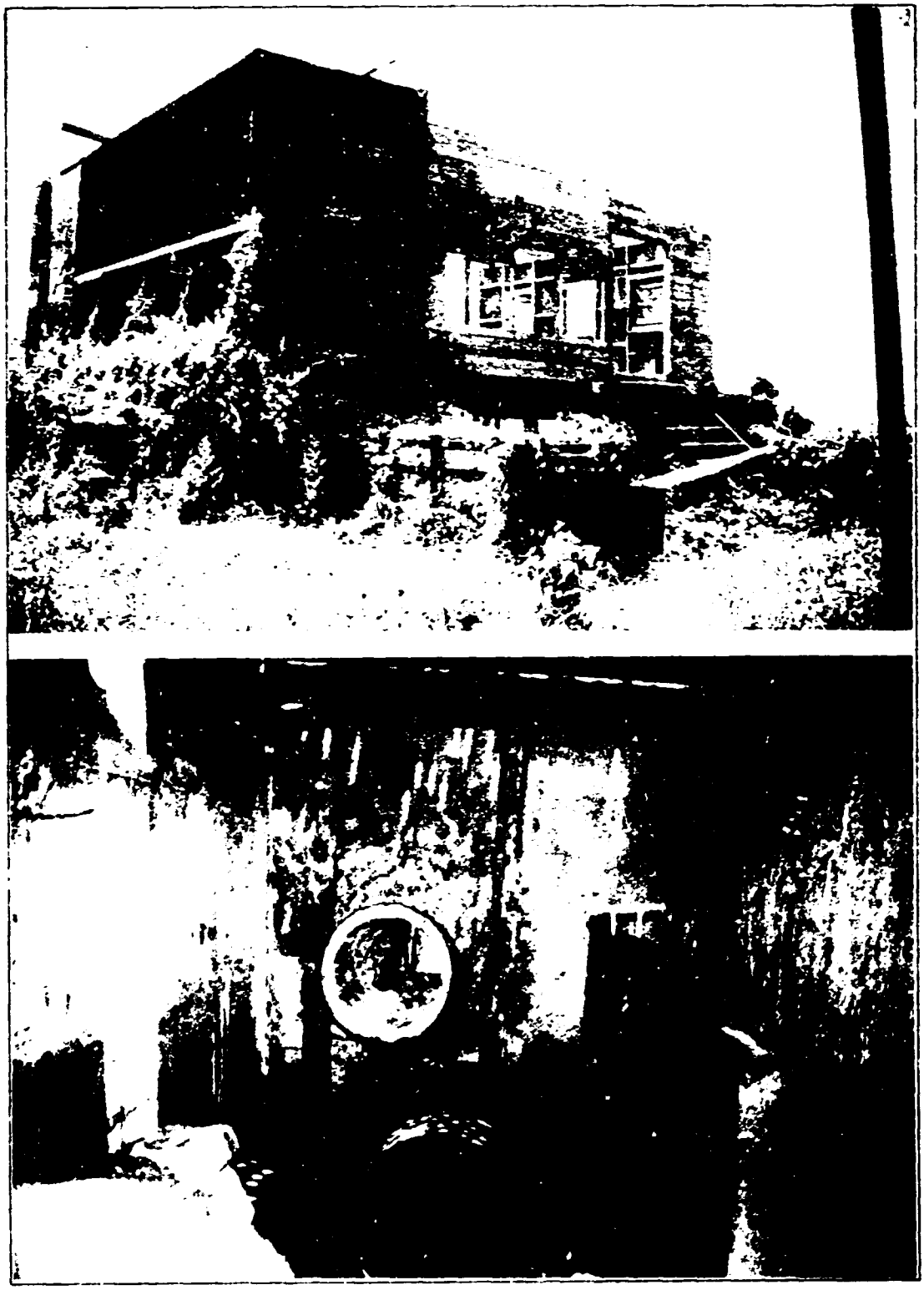

Figure 14. The idle copra drier at the plantation of the Western Samoa Trusteeship Estate Corporation. Top: Rear view of the drier showing the furnace leading towards the heating chamber; the box-like structure on top of the heating chamber contains the drying trays. Bottom: Inside the heating chamber looking towards the furnace from where the brick-lined pipe conveys the heated air through an oil-drum pipe which turns around and discharges the smoke and flue gases through the smaller diameter pipe at the upper right portion of the concrete wall (seen on the left side in top picture).

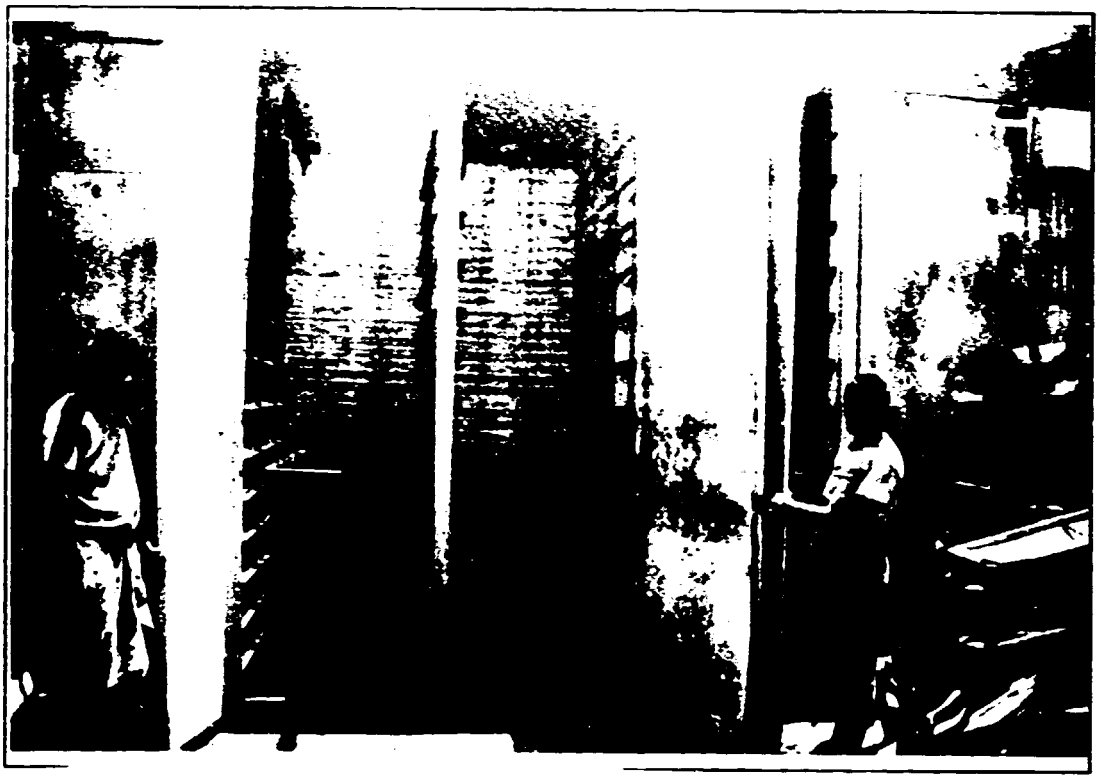

Figure 15. Drying chamber where trays containing coconut meat are placed on shelves.

In some primitive models, there are no heating tunnels. Inside the chamber, coconut shell halves are lined up on the floor in domino or snake-like fashion and fire is started at both ends of the line (Figure 16). The shells burn continuously and by the time all the fuel have been consumed the coconut meat is dried completely, hence the copra.

Since the coconuts are not harvested from the tree top, gathering them is time consuming. A disadvantage is that the nuts are gathered and processed during way past their maturity and oil content has diminished. Gathering from the tree top can be done only by climbing as there is no tool available for harvesting the nuts from the ground, like the method used in Asia.

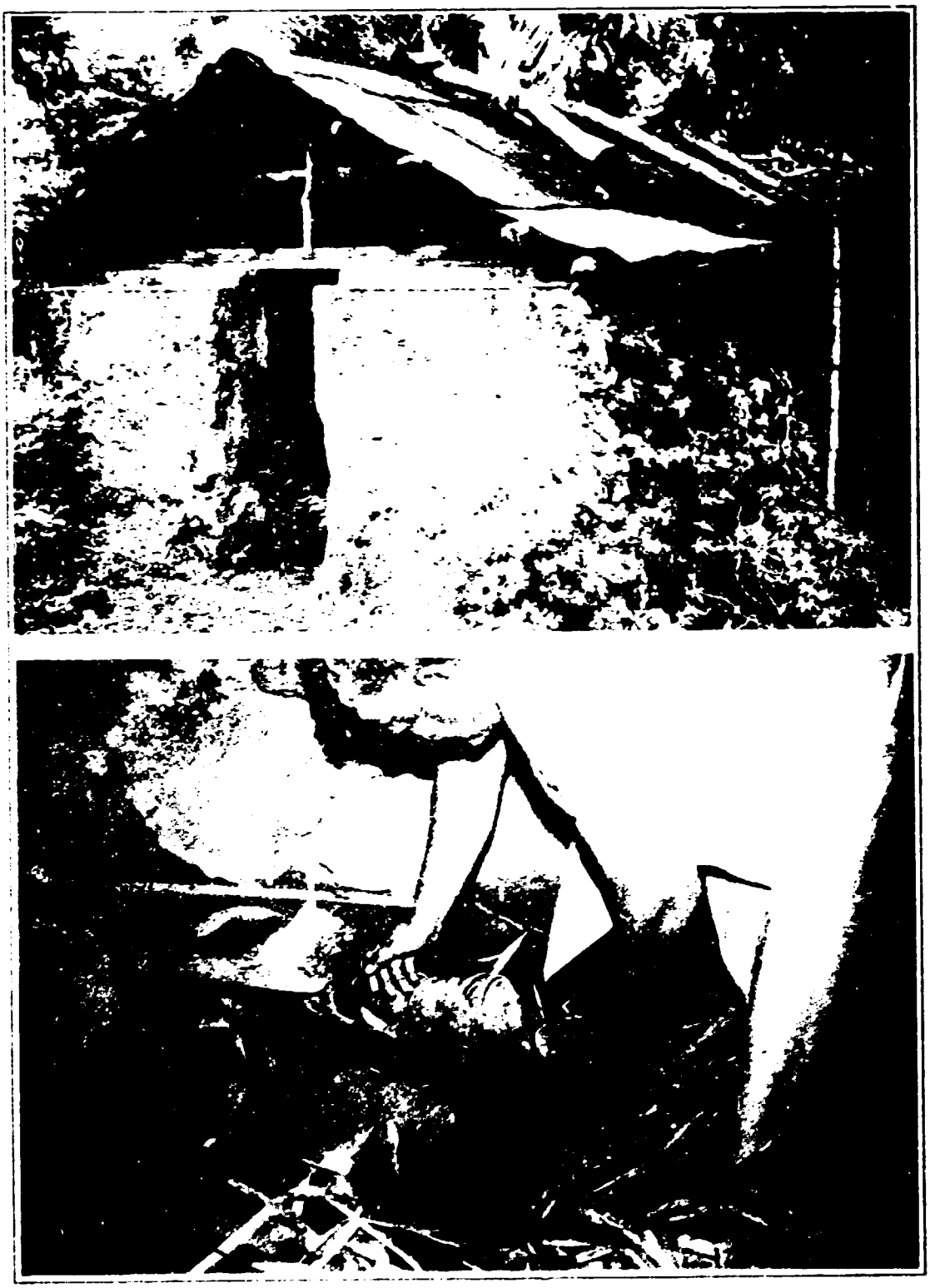

Figure 16. Small farm holder's copra drier where smoke contacts the coconut meat being dried. Top: The rock-walled heating chamber on top of which the coconut meat is spread on wood slats; Bottom: Inside the heating chamber, coconut shells are lined up in domino fashion for continuous burning.

(c) Cocoa. Harvesting cocoa pods and opening them up to get the seeds which are the useful product present no tooling problems. However, to prevent damage to the tree, the pod should be cut at the base of the stem instead of twisting them by hand or poking them by a tick or pole. A bush knife is used to open the pods. Sometimes a wooden stick is used to break them. The processing equipment which consist of a fermenting box and a drier are mostly wooden.

Fermentation of the fresh cocoa beans takes 6 days. The batch of cocoa beans is stirred every two days. A normal batch for drying consists of 5 sacks of fermented beans with a total weight of about 650 kg. In operation, three persons of family labour work in three shifts to operate the dryer. Each person receives WS$10 per day of work including the field gathering and processing of the cocoa pods. The yield after drying is about 3.5 sacks of dried beans ready to be marketed. One sack costs about WS$170.

The drier usually consists of rectangular heating chamber with walls made out of rocks which are abundantly found in the area. The heater is a 40-cm diameter pipe made from gage 18 mild steel sheet or oil drums connected end to end. One end is the firing place where wood fuel is burned and the other end connects to the chimney pipe via a small chamber with a small-diameter exit to accommodate the chimney pipe. This contraption requires only a minor welding job. It is effective in holding back the heat escaping through the chimney pipe. Smoke does not come in contact with the fermented beans being dried. Figure 17 shows a typical cocoa drier with rock walls. Shown is one drier whose shed was damaged by the cyclone and has been idle for three years due to lack of raw materials to cyclone-damaged cocoa trees.

On the top of the drying chamber is the screen surrounded with about 250 mm tall sidings to contain the fermented cocoa beans for drying. Drying takes about 24 hours.

The dried cocoa beans are sold in the market in small or handful size quantities. There is no cocoa grinding industry and the beans are processed at home by roasting and and then pounding.

(d) Banana. The bush knife is used for clearing the land and the oso for digging the holes to deposit the banana suckers or corms. Only the bush knife and the desuckering tool are used in the maintenance of the banana plantation.

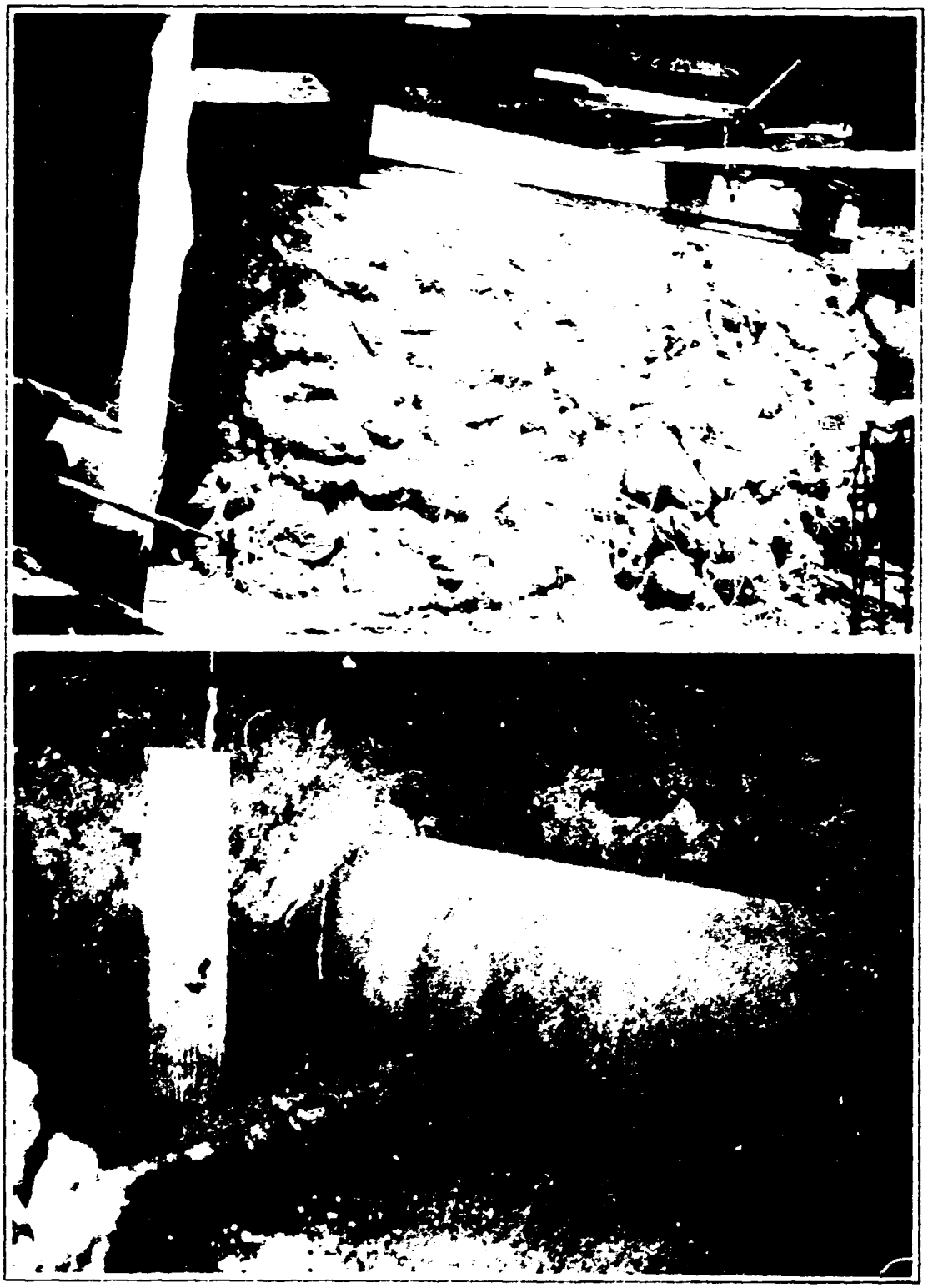

Figure 17. Cocoa drier. Top: Rear or chimney end of the drier showing the drying tray on top of the heating chamber (wood pieces have come from the collapsed drier shed); the chimney pipe connects to a 15-cm diameter pipe hidden by the small mound of rocks for insulation. Bottom: Inside view of the heating chamber looking towards the furnace end located outside the heating chamber; the 50-cm diameter mild steel pipe which acts as the heat exchanger exits directly at the constricted chimney end.

D. Demand for agricultural machinery

Under a subsistence level of farming, the demand for agricultural tools and machinery is small. Only the basic hand tools are required, except by a few who are beginning to see the benefits of commercial farming. They invest in small-engine powered machinery, like sprayers for chemical weeding, grass cutters for mechanical weeding and chain saws for land clearing or cutting the second growth forest and dead trees.

Since commercial farming is beginning to emerge, there is an expected demand for tools and machinery. However, unless some intervention is made to introduce animal-drawn implements, the recourse is to use tractors which at present are not suitable for the rocky terrain. Hence, a prior development of the land, that is clearing of rocks is needed.since furrow or rotary tillage could not be practiced without such clearing or land development. Moreover, soil conservation tillage practices need to be introduced and adopted first by the farmers before any form of modern tillage practices is to be introduced. This is because such modern tillage practices if not accompanied by appropriate soil conservation technology could be disastrous to the fragile ecology of the Western Samoa islands. An irreversible soil degradation can be brought about by erosion.

The pressure to cultivate the land is not yet felt in Western Samoa. The younger generation generally wish a non-farming life style and go abroad. The relatives abroad generally sustain the home family whose members generally see no reason to work hard. But as restrictions to immigration in the favourite countries, namely New Zealand, Australia and the US, get tighter, Samoans would be forced to stay home and do farming.

E. Production of agricultural machinery

The production of appropriate tools and machinery in Western Samoa, will depend largely on the progress of adoption of agricultural technology and the adoption of the farming system as well as on the future plans of the Government regarding its agricultural and industrial development.

Except for two types of hand tools, namely the taro hole digger or "oso" and the coconut meat scraper or grater, virtually all agricultural tools and machinery are imported notably from developed countries. No tool or agricultural machine is imported from any developing country. like that in Asia where the climate and soil conditions as well as the kind of crop grown are similar to those prevailing in Western Samoa and where more appropriate tools and machinery are likely to have been developed. The tools and machinery currently sold in the market have been introduced mainly on the basis of commercial decisions as there is no institution which undertakes testing and evaluation of such tools and machinery. Moreover, the importation of such tools and machinery has been mainly done by a single and government-owned enterprise, the Agriculture Store Corporation (ASC) and to some extent by two other hardware stores. Farmers, are constrained to buy whatever is offered by the corporation and the other distributors.

There is potential for blacksmithing as hand tools, like the bush knife, oso, coconut grater, hoe head, ax head, rake and trowel can be made from scrap high carbon steel. Discarded vehicle leaf springs which are readily available and it would be advantageous if they are recycled into hand tools. Wood charcoal can be made available as dead trees in the aftermath of two consecutive years of cyclones are abundant. However, blacksmithing must be taught as it is still an unknown art and technology among many Samoans.

III. ECDC/TCDC POTENTIALS

The following cases are opportunities for cooperation between Western Samoa and the other developing countries in Asia and the Pacific.

Introduction and production of new models of hand tools

Virtually all the tools used for agriculture in Western Samoa are imported. The bush knife which is a basic tool and the brush knife, an indispensable one for cutting grass and other weeds which grew luxuriantly under the favourable soil and climate of the Western Samoa could be substituted or complemented with locally made ones, if facilities and skills could be developed. The indicative market for a substitute, which would be cheaper and more effective than the imported one, would be large enough for blacksmithing enterprises.

The change-over to a new make or model, however, might encounter difficulties and resistance since the current design had been in Western Samoa since the start of colonial days and work habits had already been developed. Nevertheless, opportunities for achieving better and more work results with new designs are needed to be explored and in the promotion of new models, perseverance would be necessary. The logical source of such tools would be the developing countries in Asia and the Pacific where crop, soil and climatic conditions are similar. Thus, a potential for ECDC/TCDC is first to promote new models of tools for try-out among selected users who could have strategic stature to influence changes should new tools be found better than the traditionally imported ones.

Promoting commercial agricultural system versus the traditional subsistence level system.

The changing of rural economy from the partly to a fully monetized one or from subsistence to commercial agriculture needed technology adoption, which should consider not only the right kind of technology but also the method of introduction to be effective. Although efforts in strengthening the agricultural extension system are being made, there are still several gaps in extension services which need to be filled for effectiveness. Farmers are slow in adopting the technologies. One reason perhaps for such slow adoption was the inappropriateness of the technology to the local conditions, lack of sustainability of such technologies and weak human resources capabilities or lack of motivation in extension work.

International technical assistance for inducing farmers to adopt technologies are being given by some countries. There are volunteers from the US and Japan assigned to rural areas trying to introduce changes. Some of the assistance programmes appeared to be effective but also sometimes not sustained for some reason after withdrawal of the technical assistance.

The transport system for the rural areas needs to be improved to achieve efficiency in the movement of commodities and people. Motor tricycles are a common feature in rural and urban areas of Asia but has not yet gained any foothold in Western Samoa. A reason perhaps is that nobody among the Western Samoans has the training nor the technical and financial capabilities for making one. Introducing motorized tricycles will impact on the livelihood of the people in the rural areas. The lack of transportation is one deterrent for moving from the subsistence to the commercial level of agricultural production.

IV. PROBLEMS AND CONSTRAINTS

The following are some of the major problems and constraints to rapid development of the agro-related metalworking industries in Western Samoa:

(a) Subsistence type of agriculture which is brought about also by certain cultural system such as the customary land ownership which inhibits commercial type farming in a way. However, with proper strategies, thids ownership system can be taken to advantage as there is land consolidation in the aiga;

(b) Cultural barrier in the promotion of cattle rearing which is essential in promoting animal draft power for pulling implements and carts;

(c) Lack of industrial skills arising from outmigration of those who have had the opportunities to acquire education and develop mechanical skills and knowhow;

(d) Lack of entrepreneural skills to start metalworking enterprises; For example, blacksmithing could be initiated at least by those who have been exposed to metalworking.

(e) Lack of land pressure as population is small and those with relatives working and residing abroad are an assured source of money because of the strong family ties.

V. CONCLUSIONS AND RECOMMENDATIONS

A. Agro-related machinery needed

New designs of hand tools, particularly the bush knife, brush knife, hoe, digger, dryland weeder and rice production hand tools are needed for copying by blacksmiths, should there be training to develop them.

The following are the types of machines which are needed according to the

progress of development in agriculture and the capabilities in the fabrication of agro-related machinery. Some may be procured for demonstration or trials in farmers' fields.

Agricultural hand tools

(a) Heavy duty wood knife with sheath;

(b) Curved blade bush knife;

(c) Curved blade brush knife with serrations;

(d) Sickle with serrated blade;

(e) Trowel, trough type;

(f) Trowel, flat blade type;

(g) Trowel, claw type;

(h) Taro digger, pointed and flat blades, wood handle;

(i) Hand-pushed weeder for dry land, three models;

(j) Tripod-mounted and portable coconut husker along with husking accessories;

(k) Coconut harvesting knife complete with extendible bamboo poles

(l) Coconut meat separator, spoon type;

(m) Coconut meat scraper or grater, rotary type and

(n) Coconut harvester, sickle.

Animal-drawn implements, harness and accessories

(a) Single-ox drawn steel plough;

(b) Single-ox drawn peg-tooth harrows;

(c) Single-ox drawn inter-row cultivator;

(d) Single-ox drawn carts with steel wheels and axles, rubber tires and wooden bodies complete with harness and accessories and

(e) Horse saddlebaskets.

Mechanical-powered machinery

(a) Coconut oil expeller;

(b) Oil filter press;

(c) Sugarcane crusher,electric motor-driven;

(d) Cocoa grinder and

(e) Motorized tricycle (motorcycle with side-car).

B. Agricultural Machinery prototypes and drawings for exchange with other LDCs

There are no agricultural machines which can be exchanged by Western Samoa with other countries.

C. Policies and strategies

Institutional support programmes

(a) The need for establishing an agro-related metalworking industry

The infancy status, if not lack of a viable metalworking industry in Western Samoa, had probably cost the country in foregoing several development opportunities. The absence of even a blacksmithing industry, for example, had caused a dependence on importation of many simple tools, like a bush knife or ax head which could otherwise have been produced locally and caused an evolution of tool designs appropriate for the conditions of Western Samoa. Among the benefits forgone include savings in foreign exchange, creation of employment, utilization of scrap metal which is abundant, lower-priced and more appropriate tools and developed human resources in the metalworking industry to spin off other industries. In some industries, due to lack of qualified local personnel with exposure to metalworking or mechanical equipment, expatriates have to be hired or encouraged to set up their metalworking enterprises.

Basic wheeled vehicles for short movement of goods by human, animal or motorcycle power had not developed unlike in Southeast Asia. The promotion and development of small-scale agro-related metalworking industries, including agricultural hand tools, animal-drawn implements and vehicles and motorized tricycles therefore, can start off the establishment of other metalworking industries. The use of animals for draft work can even catalyze the rearing of livestock which DAFF is trying to promote. The alternative strategy is to wait until the cattle husbandry technology is adopted or has become popular.

It is therefore, recommended that DAFF, in coordination with the Department of Trade, Commerce and Industry, follow up the catalytic activities initiated during

the country visit of the Consultant and, even before the start of the Phase II of the project, sustain the contacts made with the existing metalworking industries.

(b) Strategy for promoting new farming technologies, including tools and machinery

The "Fa'a Samoa " or Samoan way of life tends to offer resistance to change, especially if such change would entail extraordinary efforts, new work habits and, in general, a modification of the way of life itself. Agricultural extension which must include activities in tools and machinery extension or vice-versa will need patience and perseverance on the part of the extension workers and initial failures in such attempts would not be surprising.

Since old habits and preferences are difficult to change in spite of obvious advantages of the new methods, a strategy is to start with the young who would not have such biases. It is recommended that a course in practical gardening simulating the recommended farming system be developed by DAFF in collaboration with the Ministry of Education for introduction to the primary and elementary school children starting with the fourth level or grade. Should the children be farmers in the future, as most of them will, they would have already been exposed to the modern farming technologies and would be more receptive in future innovations than their parents would be.

It is further recommended that DAFF, together with the Ministry of Education, coordinate with and seek assistance of USP School to Agriculture regarding the development of the school curriculum for the school children to infuse simple but scientific and practical innovations in the elementary school education system in line with the above concept.

(c) Introduction of tools and machinery and agricultural engineering technologies

The introduction of locally manufactured tools and machinery should be integrated with that of new farming systems or be closely coordinated with the on-going WSFSP implemented by DAFF. Moreover, for a more comprehensive technology development which is aimed by WSFSP, the farming system technologies should include those on agricultural engineering, such as soil and water conservation, environmental protection, proper tillage practices, irrigation and drainage, management of water resources, farm structures as well as tools and machinery. DAFF does not have the human resources capable of undertaking the programmes and activities which are allied to agricultural engineering.

It is recommended that DAFF coordinate with the Agricultural Engineering Section of USP School of Agriculture and USP/IRETA regarding the WSFSP and the tools and implements needed to support the farming systems activities. The close linkage with USP Agricultural Engineering Section will also catalyze the PACNATI country programmes in Western Samoa. Any relevant outputs of future programmes under Phase II of the UNIDO-assisted project on promotion and development of

agro-related metalworking industries will be disseminated to the other island countries participating in PACNATI through the communications network facilities of USP which provides the secretariat services for the network.

Institutional support development

Based on the findings and observations as well as on the discussions with government officials concerned, heads of institutions, private metalworking entrepreneurs and the UNDP staff, two options for providing institutional support for the promotion and development of the agro-related metalworking industry in Western Samoa are given below:

(a) Option 1. This option proposes as an objective, the establishment of an agricultural engineering institutional support, not only for the agro-related metalworking enterprises yet to be established but also for the agricultural engineering technologies of which DAFF has no expertise. The institutional support will require creating a post for one agricultural engineer at DAFF and establishing a small fabrication and blacksmithing workshop at the Nafanua Agricultural Station, where a building with adequate space already exists. The workshop will be operated by three workshop technicians who will also be recruited.

(b) Option 2. This option does away with the more formal though modest institutional support provided for in Option 1 and instead, only a coordinating officer, possibly a senior agricultural extension officer with specialization in agronomy would be assigned to follow up and coordinate the activities of the project. Since the coordinating officer will more likely have inadequate knowledge in engineering and metalworking, the required expertise will be sought from USP and WSP. The coordinating officer will have to seek assistance from USP for engineering backstopping in design and development of agricultural tools and machinery and from WSP for workshop technology, particularly in fabricating the new tools and prototypes as well as for on-the-job training of the private metalworking workers.

With suitable institutional arrangements, technical collaboration may be made by DAFF with the two institutions in design and development and fabrication of prototypes. Currently, Option 2 will be more realistic than Option 1 because of the following reasons:

(a) Although DAFF considers it necessary to have an agricultural engineer to plan and implement agriculture programmes needing engineering knowledge, a new post would be unlikely created by the Government as it is short of funds. Moreover, the Government gives priority to the rehabilitation of infrastructures damaged by two cyclones which hit Western Samoa in 1991 and 1992. For the same reason, three new posts for workshop technicians would not likely be created, although some redundant technicians from the vehicle repair workshops of DAFF may be trained in fabrication workshop technology and assigned to the proposed new workshop. Such a move however, also needs local funds for re-training of the technicians in machining, welding and fabrication of agricultural machinery at WSP or abroad.

(b) Even if funds for a new engineer post were available, there would still be the problem of recruiting and retaining a qualified agricultural engineer for the post. In the past, a large number of trained human resources tended to seek jobs in the private sector or abroad, particularly in New Zealand and Australia.

Therefore, a strategy for promoting agro-related metalworking industries through institution building as provided for in Option 1 at this point of development will not be feasible nor appropriate unless the above-mentioned constraints are overcome.

Agricultural machinery and related engineering technologies

(a) Chemical weed control

Due to the favourable climate, the fertile volcanic soil and the rocky nature of the land, minimum or zero tillage has been practiced by farmers in the cultivation of taro, alocasia and vegetables. Weed control however, has always been a constraint in obtaining high yields. Weeding is a pre-occupation of farmers, particularly the women because the taro or any newly planted crop, like banana, breadfruit or tree sapling, can easily be overwhelmed by weeds which grow profusely and rapidly.

The traditional practice of cutting the weeds and letting them rot on the field provides biomass and allows for a continuously fertile land. Recently, however, there is a large usage of herbicides which has caused a large demand for hand lever-operated knapsack as well as engine-powered sprayers and mist blowers. Herbicides appear to be effective for weed kills but only for three to four weeks, after which the weeds revive and spraying has to be done again.

In spite of claims by chemical manufacturers to the contrary, herbicides may still cause environmental damage to friendly insects and wildlife. A tragic outcome is that suicides among the youth in Western Samoa have been facilitated with the use of the poisonous chemicals, prompting the Government to consider banning certain weed killers with high toxicity.

Improper or careless handling and usage by farmers present a slow or cumulative poisoning hazard of which they may not be aware. This is exacerbated by the handling of water for diluting the chemicals. Rain water is commonly collected for domestic use as well as for spraying.and then transported to the field where 200-litre drums are used for storage. The danger of contaminating the domestic rain water supply is always present.

The popular use of herbicides by farmers is attributed to the comparative economic advantage of chemical weeding over mechanical weeding. However, the health and environmental hazards, especially under conditions of lack of their awareness by users or farmers, should merit serious consideration by the Government. The use of herbicides or chemical weed killers and more so, of the more toxic insecticides should be controlled. Diseases due to chemical spray inhalation and skin contact with the chemicals are often insidious and the effects are

not immediately discernible as they are cumulative. The seemingly harmless results in every spraying operation give a false sense of health security to the operator. Protective gear, in spite of campaigns for its use has not really been used due to the discomfort in warm climate. If the simple care and maintenance of small engines for sprayers and mist blowers could not be adequately done as evidenced by the common repair requirements with damages pointing to inadequate lubrication care, then the more complicated care of handling of chemicals would be greatly hazardous.

It is therefore, recommended that until a satisfactory handling of chemicals for weed and insect control is adopted by farmers to protect themselves and the environment from their hazards, the use of chemicals should at least be controlled. While insecticides seem to be not as widely used as weedicides, DAFF should already introduce the concepts of integrated pest management.

(b) Mechanical weed control

A common characteristic of the noxious weeds normally infesting the fields is their ability to regrow after being cut. The farmer has to repeat the operation after about three or four weeks as cutting only rejuvenates them. Improvement of the weeding technology to bring about effective, safe, less costly and environment friendly weed control merits priority. The improvement may consist of the right method coupled with the appropriate weeding tool technology which may be promoted through an effective extension work. The following strategies for weed control are recommended:

(i) Promote the use of a specially designed hoe, spade, digger or trowel to uproot the grass weed without or minimally breaking the root system but leaving the soil behind by shaking it off the roots. The roots gathered should not be made to make contact with the soil and should be dried but not burned to kill them. The method may be laborious but control of the weed can be permanent after two or three passes (after regrowth of missed roots) depending upon the thoroughness of the weeding operation. It is essential to prevent weed re-infestation by isolating the area, for example, by practicing the contour bunding as suggested in item 2 below. However, broadleaf types of weeds which are easier to control than the grass type may succeed the newly eradicated weed. The tool should be acceptable to the operator by making it effective, easy and increase labour productivity. Once accepted and popularized, local fabrication of the tools by blacksmiths who shall be trained may be promoted;

(ii) Promote the use of an animal-drawn or power tiller-drawn digger which will do the same function as in item (i) above but will require prior land development as described in item (c) below;

(iii) Test and promote the use of curved blade bush knife for more effective and efficient cutting of grass type weed than the currently popular straight bush knife. Improved designs of the bush knife will complement the hoe or digger which will be effective only when the top growth of weeds is cleared first. Similarly, test and promote other designs of bush knife for cutting woody stems.

(iv) Test and promote the use of a rake or a suitable claw-type design for gathering the vine type of weed for piling or composting. This vine has a weak stem and breaking it into several pieces will only assist it in multiplying itself. The effective way to eradicate it is to get the root system out with the hoe and dry it under the sun without any root part touching the soil.

(v) Test and promote the use of black polyvinyl plastic which is resistant to ultraviolet rays as mulch to prevent sunlight from penetrating the rows or vacant spaces of the plantation and thus would eradicate the weeds without any cultivation. However, this material is an import and therefore, expensive but can be used several times unlike herbicides. Therefore, the use of black plastic can be more cost effective than that of herbicides besides incurring no health hazard. To save on plastic material, weed leaves and stems may be utilized as complement mulching material.

(vi) Promote the use of biological weed control, that is, combine the methods described in (i) to (v) above with the planting of a less noxious and shallow-rooted soil cover, like lawn grass. If adequately maintained, the new grass cover will permanently prevent the growth of the problem weeds, not compete for soil nutrients with the deep-rooted crop, like taro and provide a soil "bioskin" to prevent erosion. Then, combine further with raising of sheep which would eat or trim the said grass but not the crop.

(c) Soil conservation tillage farming system

(i) Contour farming

The change in farming system from the present practice of minimum or no tillage as in taro planting may cause environmental degradation and soil nutrient depletion unless technologies, like terracing and strip cropping along contours are practiced. Soil erosion can be prevented by contour farming which in the Samoan case will need initial labour investments for building rock bunds or fences. The raw materials are the abundant rocks scattered in the field which prevent the common practice of line cultivation. The labour involved is the gathering and piling of the rocks along contour lines. The main cropping area or strip of land between contour rock bunds will be cleared of rocks except, perhaps for large boulders. However, the design of the contour rock bunds may consider running them through the locations of such immovable boulders.

Contour rock bunds may be used as convenient references for or actual boundaries of land properties if agreed upon among the matai neighbours. If established continuously across properties, the contour rock bunds or fences will form a scenic terraced landscape. This system is also useful for delineating boundaries for land inheritance purposes.

Apart from preventing soil erosion, the contour rock bund will check weed growth or reinfestation in the cultivated contour strips. Moreover, it will protect the cropped area against loose animals, a deterrent to planting backyard vegetables.

With these technologies appropriate tools and machinery will be needed. For example, to make rock bunds along the contour lines, a rock picker and wheelbarrow will be needed as the hand-picking method is perhaps too tedious, laborious and discouraging for the Samoan farmer.to do.
Such land development can be slow, especially if the land pressure is not yet being felt as it is at present.

(ii) Sloping agricultural land technology (SALT)

This technology is similar to contour farming. Hedgerows of perennial plants which may be harvested for forage are planted along contours. They provide a barrier to soil erosion. Tools needed for this is the forage harvester which may consist of a curve knife and then a forage cutter. Composted biomass assures the return of nutrients to the soil.

(d) Animal-drawn implements and carts

This is a technology yet to be introduced. However, it requires the development of animal husbandry which DAFF plans to promote. A successful introduction of cattle rearing will encourage training the animals to pull loads.

It is recommended that an assistance programme for livestock production be initiated by FAO with a view to utilizing the animals also for draft work.

(e) Coconut harvesting

Harvesting of coconuts every 45 days and coinciding with their maturity stage when their oil content is at its peak is highly advantageous although it requires the practice of a new method. Instead of the current method of gathering nuts which have naturally fallen and therefore, are way past their maturity stage for optimum oil content, the coconuts will be gathered from the tree top using a coconut harvesting knife attached to a light extendible pole. If such a tool were made available and the harvesting system introduced, production of oil could be increased even without increasing the current coconut yields. This tool and harvesting technology which is well-developed in the Philippines and other coconut-producing countries can be transferred to Western Samoa. The harvesting tool can be locally made by blacksmithing which is yet to be introduced.

It is recommended that the coconut harvesting knife be one of the tools which should be introduced to Western Samoa. Along with it, is the blacksmithing technology and the harvesting system which involves gathering, husking and field transport.

(f) Rural transport

There is virtually no indigenous transport facility in the rural areas. Farmers and villagers have to depend upon hired or borrowed motor vehicles, like pick-up trucks owned by relatives or private ones for hire, which can be inconvenient and

time-consuming to arrange. Moreover, field-to-road transport is not normally served unless there are farm roads.

Animal-drawn vehicles would require training farmers in animal rearing for pulling loads as well as developing capabilities in the country for fabricating carts. Such capabilities will also lead to use of animal-drawn implements.

Another possible rural transport is the motorized tricycle which can be assembled by small-scale metalworking shops when given training or actual machines to copy. Such vehicles are versatile and can be used for personnel as well as for transport of produce up to a payload of 300 kg.

It is recommended that a programme for building carts be initiated in places where cattle rearing has taken place. The strategy is to encourage village craftsmen to build wooden cart bodies onto steel wheel and axle kits fabricated and assembled by small-scale metalworkshop enterprises from scrap motor vehicle parts. When the full-scale animal husbandry technology has been adopted by farmers, use of animal-drawn carts will likely be adopted. On the other hand, if some farmers who already practice cattle rearing also utilize animal-drawn carts and implements, the demonstration effect will induce other farmers to rear cattle for the same purpose.

It is further recommended that a programme to introduce the fabrication and assembly of motorized tricycles be initiated by popularizing the use of the vehicle and providing technical assistance to interested metalworkshops in fabricating and assembling tricycles using motorcycles as power units. Designs could be obtained from Asian countries where tricycles are popularly used for short-distance trips either for passenger or for light hauling services.

(g) Blacksmithing

Blacksmithing, is an unknown art and technology among the Solomon Islanders. Even the basic hand tools used for farming and gardening are imported.

Developing a blacksmithing industry in the villages will provide advantages of convenience of tool procurement especially those who have limited access to transportation to the city or provincial capital. Moreover, tools can be made according to the specifications of the farmer-user, especially women, and will therefore increase productivity. Raw materials can be procured by the blacksmiths themselves from the town or by those who seek the blacksmith's services.

With proper training in design and heat treatment technology. blacksmiths can produce improved tools adapted from designs commonly used by farmers in Asia whose working conditions are similar to those of Solomon Islands.

It is therefore, recommended that blacksmithing technology be introduced by DAFF and external technical assistance for training of trainers and provision of catalytic equipment be sought. A pilot and demonstration blacksmithing shop or

smithy may be established at WSP.

D. Programme for further development of the agro-related metalworking industry sector.

The need for establishing an agro-related metalworking industry

The infancy status, if not lack of a viable metalworking industry in Western Samoa, had cost the country in foregoing several development opportunities. The absence of even a blacksmithing industry, for example, had caused a dependence on importation of many simple tools, like a bush knife which could otherwise have been produced locally and caused an evolution of tool designs appropriate for the conditions of Western Samoa. Among the benefits would include savings in foreign exchange, creation of employment, utilization of scrap metal which was abundant, lower-priced tools and developed human resources in the metalworking industry to spin off other industries. In some industries, due to lack of qualified local personnel with exposure to metalworking or mechanical equipment, expatriates have to be hired. Basic wheeled vehicles for short movement of goods by human or animal power had not developed unlike in Southeast Asia. The promotion and development of agro-related metalworking industry therefore, could start off the establishment of other metalworking industries.

It is therefore, recommended that DAFF in coordination with the Department of Trade Commerce and Industry, follow up the catalytic activities initiated during the country visit of the consultant and to sustain the contacts with the interested party concerned even before the start of the Phase II of the project.

Strategy for promoting new farming technologies, including tools and machinery

The "Fa'a Samoa " or Samoan way of life tends to offer resistance to change, especially if such change would entail extraordinary efforts, new work habits and, in general, a modification of the way of life itself. Agricultural extension which must include activities in tools and machinery extension or vice-versa will need patience and perseverance on the part of the extension workers and initial failures in such attempts would not be surprising.

Since old habits and preferences are difficult to change in spite of obvious advantages of the new methods, a strategy is to start with the young who would not have such biases. It is recommended that a course in practical gardening simulating the recommended farming system be developed by DAFF in collaboration with the Ministry of Education for introduction to the higher levels or grades in the primary and elementary schools. Should the children be farmers in the future as most of them, especially those who do not have the opportunity to continue on to higher education level, would have already been exposed to the farming technologies and would be more receptive than their parents would be.

Introduction of tools and machinery

The introduction of locally manufactured tools and machinery should be integrated with that of new farming systems on be closely coordinated with the on-going WSFSP implemented by DAFF. Moreover, for comprehensive technology development as is the aim of WSFSP, the farming system technologies should include those on agricultural engineering, such as soil and water conservation, environmental protection, proper tillage practices, irrigation and drainage, management of water resources, farm structures as well as tools and machinery to implement such technologies. DAFF does not have the human resources to undertake the above consideration.

It is recommended that DAFF coordinate with USP Agricultural Engineering regarding sustained assistance in this regard, until such time that agricultural engineering capabilities at DAFF are developed.

Extent of development of the agro-related metalworking industry

The promotion and development of the agro-related metalworking industry need not be wide, as the size of the country is small and the demand for tools and machinery would be limited due to the small population. Unlike other South Pacific island countries, Western Samoa's resources are concentrated in just two major islands which is only a one-hour trip apart by ferry boat. Access to the island of Upolu which contains about two-thirds of the total population is easy.

It is therefore, recommended that the promotion and development of the small-scale agro-related metalworking industry be focussed initially at Upolu island and expand to the more sparsely populated Savaii island according to the pace of development of commercial agriculture.

ricultural engineers for DAFF staff

It is essential that DAFF have a staff agricultural engineer to take care of the engineering requirements for agricultural development. Some of the areas of concern are soil and water conservation engineering, watershed development, agricultural mechanization systems for the transition from subsistence to commercial farming, agricultural machinery development, environmental protection, post-harvest technology and processing and others. Education and training may be obtained at USP or in any developed agricultural universities in Asia.

Development of engineers for industry

Engineers are needed as technical support staff of DAFF. Education for new engineers may be obtained from established educational institutions in Asia or in the neighbouring countries of Western Samoa where mechanical engineering degree courses are offered.

VI. PROJECT CONCEPTS

A draft proposal was discussed on 18 January 1994 with the Director and Deputy Director of DAFF. In principle, the proposal was accepted but commented that the final project document should incorporate some degree of flexibility.

A. Regional Asia

BANGLADESH, BHUTAN, CAMBODIA, LAO PDR, MYANMAR, NEPAL, SOLOMON ISLANDS, WESTERN SAMOA

Title: Promotion and development of agro-related metalworking industries in LDCs (Phase II)

Duration: Two years

Total UNIDO budget: US$ 818,000

Government inputs: All governments are expected to provide services, counterpart personnel (including their salaries throughout project duration), office facilities and administrative support in kind. Details will be elaborated in the final project document.

At the end of Phase II, the following are expected:

(a) Each LDC has an effectively operating institutional infrastructure consisting of a national focal point, a national institute with workshop facilities (the two may be combined in some LDCs) with strong linkages with relevant institutions and organizations which through that focal point make active use of the regional project and any country specific project relevant to the promotion and development of agro-related metalworking industry.

(b) Each LDC has a functioning national network (NN) for agro-related machinery with members consisting of institutions and organizations from the above institutional infrastructure, private sector organizations consisting of those of farmers' and manufacturers, cooperative societies, national and international NGOs which have relevant projects or activities, banks and other credit or financing institutions, chambers of commerce and industry, and others. The NN have frequent exchanges of information and notes regarding relevant activities and its functioning depends mostly on the leadership of the national focal point or national institute. Involvement of the NN members in relevant seminar workshops exhibitions and other programmes organized by other members is an indication of a working national network. A NN newsletter (produced by the NFP) exchanges members newsletters among the NN is another indication of an active NN.

(c) Selected agricultural and agro-related machines introduced by the project have been tested, modified, manufactured, demonstrated to farmers and promoted for commercial production and use through credit financing, if necessary to farmers, manufacturers and custom service entrepreneurs.

(d) National focal point or national institute in each LDC is closely linked with RNAM and national focal points regarding agricultural machinery and agricultural mechanization.

(d) Human resources in each national institute and focal point strengthened through human resources development programme of the project.

(e) LDC national institutes have adequate facilities to undertake future development projects with or without external assistance.

Development objective

The development objective is to support the agricultural production and processing in the participating countries by improving local capabilities and generating a more conducive environment for local manufacture of agricultural tools, implements and machinery including post-harvest and food-processing equipment.

1. **Immediate objective 1**

Continue strengthening of national focal point linkages through existing network mechanisms.

Background information

Background information is available in the project document for Phase I and programme summary brief document.

Output

National focal points continuously capable of providing a flow a technical information and advice to small and medium scale enterprises in agro-related metalworking industries and initiate and sustain programmes and project in support of those enterprises.

Activities

(a) Continuation of the information dissemination system between RNAM and the focal points.

(b) Continuation of the promotion of links between the national focal points and public-private enterprises.

(c) Continuation of ECDC/TCDC promotion within the region.

(d) Continuation of managerial and technical advice to the focal points, enterprises and R&D institutions during field visits.

Inputs

CTA-Regional Adviser	To be provided by ESCAP
2 Associate Experts	To be provided by UNIDO

2. Immediate objective 2

To initiate the establishment of an information database through a database for raw materials demand and supply for the agro-related metalworking industries in Bangladesh, Bhutan Cambodia, Lao PDR, Myanmar and Nepal.

Background information

In the LDCs, most of the raw materials needed for the metalworking industries are imported. The quality of the products put out by the industries depend largely on the quality of raw materials used which at the present open economy at least for Bangladesh, Myanmar and Nepal can now be supplied by the private importers and traders.

Most of the small-scale workshops get their raw materials from the private importers and traders because of the quick response to their needs unlike in government-owned trading corporations which had been established to do bulk importation and distribution primarily to state-owned factories and secondly, to private enterprises. Many small-scale workshops face difficulties in procuring raw materials directly from the state-owned trading corporations.

In the open-market system, there is no systematic method of determining by the importers what and how much to import and supply to the metalworking industries. They estimate by experience but most often, workshops make do with whatever raw materials are best and available. Most of the workshops need assistance in specifying the best type of raw materials needed for their jobs and, even if they know, there is no convenient and effective way for their requirements to reach the importers or traders on a consolidated basis for their necessary action or response.

A database which will get the raw materials requirements and process such data for the information of suppliers will be of great help in achieving efficiency in the raw materials market which redounds to benefit the metalworking industries. Measures will be taken to ensure that accurate data is gathered from both users and suppliers.

Outputs

(a) Database headquarters established at the chamber of commerce and industry (CCI) or manufacturers association's office.

(b) Most small-scale workshops responded to the call to submit data requirements to designated collection points which relayed the data to database.

(c) Private raw materials importers and distributors making use of data in their respective operations network.

(d) Data available for exchange among the countries in the region through regular RNAM channels.

Activities

(a) Development of a database for raw material information and prepare necessary software for this database by an international consultant in one of the countries for replication in the others.

(b) Identification of an organization to manage the database. Normally, the CCI or another association with direct private sector participation would be in a position to undertake the activities of the project as it is to the interest of its members. It may have the option to expand the database to other industry subsectors to utilize excess capacity of the computer facility and staff. The database facility could be made self-liquidating by charging service fees from the users or importers who would like to have access to information. The National Focal Point (NFP) will assist the workshops in making specifications through the R&D member institutions in the National Network (NN) since they have the engineering staff who designed or tested the machines or at least familiar with them. Moreover, they are in a position to best consult and coordinate with the standards agency of the government.

(c) Formulate a strategy for obtaining correct and honest information about raw materials needs from workshops. Data gathering is a time-consuming activity which may be eased through the local business association or cooperative. Since small-scale workshop owners are not usually members of the CCI, they should be encouraged to form their own groups and federate them (refer to Immediate Objective 5). The department of cottage and small-scale industries may spearhead the move in collaboration with the NFP. One benefit to be gained by joining the association is the receipt of information through a newsletter. Workshop owners can also cooperate by returning by mail the canvass form sent by the CCI for the purpose. In return they may receive updated information on the material status over a specified period. Linkages will also be established with statistical services and other relevant databases in the country.

(d) Establishment of the database headquarters. The needed facility includes a personal computer set, a database programme, a printer and a photocopier. Only one staff trained in computer operation is necessary. This may be one of the

secretaries in the CCI office who will be trained to operate the database as one of the office duties. After all, the work only entails data entries which may be done in batches. If the headquarters decide to expand the facility to other types of raw material requirements, it may have to make staff adjustments. Facsimile facilities would be helpful in getting timely data from towns and cities.

(e) Supply of information to interested parties, particularly importers and suppliers as well as government policy and planning offices. The information may be sold at nominal cost to recover the cost of operation. The service may be expanded to other raw materials using the same computer facility and personnel.

(f) Monitoring and evaluation. Random field checking of data gathered will be done to detect spurious data. The database established for all small-scale metalworking workshops will be utilized in the monitoring and evaluation. Benchmark information on problems related to raw materials procurement will be gathered prior to the start of the project or before the effect of the project is felt. Data will again be gathered periodically to detect any changes. Data on how the small-scale workshops have been benefitted or adversely affected by the project will be evaluated.

Inputs

International expert for software development (1.5 w/m)	US$	18,000
One computer expert per country (locally recruited)		10,000
One set of personal computers with printer for each country		30,000
Six photocopiers and faxes		24,000
Miscellaneous		10,000
Component total	US$	92,000

3. Immediate objective 3

To upgrade the skills of blacksmith trainers in all participating countries.

Background information

Village blacksmiths play a major role in the supply of tools and implements to farmers in the LDCs. Most of them learned the trade from their fathers and grandfathers and some skills may have improved or deteriorated along the way. Any improvements in their operations are tied up in the kind and quality of basic blacksmithing equipment they have inherited or added to the modest facility.

There is a need to upgrade both skills and equipment to increase the productivity of blacksmiths. Having skilled blacksmiths who are given access to new technologies, such as improved tools and implements redounds to the benefit of

farmers they are serving in the villages, who also need the proper tools and implements to be efficient and productive in their farming activities.

Output

A minimum of ten trainers capable of conducting training courses in each province or district per year in each country to enable participants to manufacture hand tools.

Activities

(a) Adoption of the FAO manual in blacksmithing as syllabus for the training course.

(b) Organization and implementation of training courses by the NFP in cooperation with the Ministry of Industry or Department of Cottage and Small-scale Industries.

(c) Monitoring and evaluation of impact of regional and national training courses.

Inputs

Expert in blacksmithing technology from the region (8 w/m)	US$	90,000
Equipment - basic blacksmithing sets for selected blacksmiths		25,000
Group training programme		30,000
Miscellaneous		10,000
Component total	US$	155,000

4. Immediate objective 4

To promote the production of small-scale machinery for agro-based food-processing light industries in Bangladesh, Bhutan, Cambodia, Lao PDR, Myanmar and Nepal.

This objective includes the following sub-objectives:

(a) To catalyze the development of agro-based food-processing industries by making readily available the machinery required in the processing of food raw materials involved.

(b) To strengthen the capabilities of small- and medium-scale metalworking industries in fabricating machinery required by the agro-based food-processing industries.

(c) To strengthen the comprehensive local machinery and equipment support sub-system for the food industrial system covering that from the production and post-harvest processing of agriculture-sourced raw materials to food-processing, packaging and handling for the market.

Background information

A bottleneck in the promotion of agro-based industries, especially the small-scale ones for the rural areas, is the lack of suitable processing machinery. Most often, the needed machines have to be imported although they are simple enough to be fabricated in local small- and medium-scale workshops especially those having engineering staff and qualified technicians. New entrepreneurs may not be aware of the capabilities of the local fabricators who can satisfy their engineering requirements if given the specifications or requirements.

The cost of machinery for a small-scale agro-based processing enterprise represents a large percentage of the total capital requirements. If such machinery could be made to order locally, the potential entrepreneurs will be encouraged to invest in such industries because of the convenience and perhaps, the reasonable cost and readily available repair services.

UNIDO has made a recent (first half of 1993) report each on the development of food-processing industries in Bangladesh, Bhutan, Cambodia, Lao PDR and Nepal. Eventual responses of the governments will lead to the establishment of new industries, most likely small- and medium scale ones and privately owned. In such food-processing industries, particularly oil, sugar and rice milling as well as dairy and fish processing, special machinery are an important component and in fact, itself a major determinant of the scale of each industry type and the quality of the final products. Special food vessels and containers made of aluminum or stainless steel which can be sterilized using heat, are simple enough to be made by the local industries according to specifications and accepted standards.

In Bhutan and Nepal, fruits, vegetables and spices are grown in mountainous, rugged terrain and remote areas. Transporting the raw materials fresh is often uneconomical and discouraging because of bulk, weight, low value and perishability of the horticultural products. Hence, there is a need to process such food raw materials and increase their value per unit volume or per unit weight. Processing such raw materials will create employment in the remote areas, particularly for women. The hygienic requirements in food processing may be assured through the design of the machine, the process involved and training of the processors and handlers of the raw materials.

The project concept calls for a regional cooperative effort in exchanging machinery design information together with the processing technologies involved. For example, designs of driers of high-valued products, like fish, fruits, vegetables and meat pelletizers and mixers of feed for fish, livestock and poultry, and mills for edible oils exist in some countries which are relatively advanced in some areas. If machine exchange is not possible, information on design will be exchanged and given

to machinery manufacturers which have engineering design and construction capabilities.

Outputs

(a) At least one machinery design and technical information on the small-scale food-processing involved for raw materials such as fruit, fish, vegetable, meat, oil, sugar, grain, legume and milk, exchanged among the LDCs and other developing countries or adapted from advanced countries.

(b) At least one medium-scale local metalworking manufacturer assisted by the project resulting in its diversified production of specialized machines for small- and medium-scale food-processing industries.

(c) Strengthened national network.

Activities

(a) Identification of food-processing industries which merit high priority for development on account of highest feasibility considering the most likely sustained production of raw materials, ready market, simplicity of processing technology, low investment requirements, mass-base benefits and other criteria; decision to promote or encourage the establishment of the industry will be made in consultation with the private sector and with support of feasibility studies.

(b) Compilation of information on the food-processing technology, including the machinery requirements and sources of their designs or prototypes, costs and other data.

(c) Establishment of collaboration work with 2 or 3 medium-scale metalworking enterprises having at least one design or production engineer on its staff and with fairly adequate machine tools and fabrication facilities for staff.

(d) Provision of technical advice to entrepreneurs in food-processing industries and maintenance of collaboration work with them to enhance their productivity, maintain quality control and hygienic production conditions, reduce waste, protect the environment and perform other activities for promoting the food-processing industry in general.

(e) Training of trainers in small-scale food processing using the locally fabricated food-processing equipment.

(f) Initiatives by the National Focal Point to maintain constant contact with institutions and organizations for co-ordination activities regarding the sustainability of the food industrial system, e.g. promotion of contract growing among farmers for supply of raw materials for the food-processing plant, giving designs or technical advice/prototypes of agricultural machinery to metal workshops for fabrication or replication.

(g) Organization of a national demonstration workshop for manufactured equipment prototypes to interested entrepreneurs.

Inputs

Expert in food processing equipment manufacture 2 w/m per country X 6 countries = 12 w/m	US$	150,000
National consultants in food-processing to coordinate field activities, 3 w/m x 6 countries		12,000
Preparation of demonstration workshops		12,000
Food processing prototypes		15,000
Materials and supplies for manufacture		15,000
Miscellaneous		5,000
Component total	US$	209,000

5. Immediate objective 5

To promote and develop commercial machinery prototypes for all participating countries.

The immediate objective has the following sub-objectives:

(a) To acquire from LDCs, RNAM member countries and other sources, commercially available machinery identified as needed in the agro-industrial system project for adaptation to local conditions.

(b) To test, modify and replicate the prototypes acquired from other countries and introduce them to farmers, manufacturers and potential entrepreneurs dealing in custom hiring.

(c) To promote the commercial manufacture of the adopted prototype through marketing strategies.

Background information

Often a machine that is suitable for the job in the agricultural production or processing stage in the agro-industrial system is available from other countries. Effort, time and money for R&D to design and develop a machine will be saved if the machine could be acquired through an institutional facility like the Regional Network for Agricultural Machinery (RNAM), a project of 11 Asian countries executed by ESCAP.

The National Focal Point (NFP) in the recipient country turns over the machine to the R&D institution most appropriate for testing, modifying and adapting the machine to work under local conditions. From the experience of RNAM, commercial, rather than experimental prototypes should be exchanged. If no commercial machine is available but R&D efforts have resulted in an experimental

prototype, drawings or conceptual designs may be requested as sources of ideas. In all cases of exchanges, proprietary rights have to be respected and permission from the inventor or designer will be obtained.

Output

Entrepreneurs capable of manufacturing the introduced prototypes in respective countries.

Activities

(a) Machinery demand survey of the machines identified under Phase I. The initial list of hand-operated tools and devices, animal-drawn implements and mechanical powered machinery is included in the detailed report prepared for each country. The prioritization of the final list of machinery is to be done by the NFP in consultation with the leaders of various sub-projects, the R&D institution members of the NN and the agro-industrial machinery expert.

(b) Testing, modification and field or factory trials of the machine by the R&D group in cooperation with one or two manufacturer co-operators and the farmers or the processors depending upon the application of the machine. This activity involves the participation of several persons connected with the agro-industrial system project. The NFP who plays a lead role in the machinery NN will coordinate the activities of all the people involved to ensure success of the sub-project which involves perhaps more than one machine to be developed. Typical assignments are fabrication by a co-operating manufacturer of a modified component or assembly, testing of a part for durability by the engineering laboratory of a university, organizing a discussion group to brain-storm on possible solutions to a technical problem, machinery trials in a farmers field or in a processing plant to demonstrate the superiority of the machine over the traditional or existing ones, replicating the machine in one or more manufacturers' workshops, organizing demonstrations for introducing the machines, conducting trial custom work or renting services in cooperation with an entrepreneur, mapping out strategies with the extension units with technical backstopping by the R&D units, etc. The avenues for collaboration are many.

(c) Monitoring and evaluation by organizing demonstration workshops at the end of the manufacturing process.

(d) Extension and commercialization of the machines. These activities are covered by a strategy suitable for different agro-ecological zones of the country. Farmers, agro-industrial processors, manufacturers and custom work service entrepreneurs are the important targets of the extension activities.

Inputs

Agro-industrial machinery expert from the region (8 w/m)	US$	92,000
National consultants (16 w/m)		30,000
Demonstration workshops		20,000
Procurement of commercial prototypes - At least 3 machines/country x US$ 2,000/ machine for 8 countries		50,000
Replication of prototypes for demonstration		30,000
Miscellaneous		20,000
Component total	US$	242,000

BUDGET SUMMARY
US$

Objective 1 (networking)

Component total covered by contributions in kind

Objective 2 (raw material databases)

Personnel	28,000
Equipment	54,000
Miscellaneous	10,000
Component total	92,000

Objective 3 (village metalworking)

Personnel	90,000
Training	30,000
Equipment	25,000
Miscellaneous	10,000
Component total	155,000

Objective 4 (food-processing equipment)

Personnel	162,000
Training	12,000
Equipment	30,000
Miscellaneous	5,000
Component total	209,000

Objective 4 (commercialization of prototypes)

Personnel	122,000
Training	20,000
Equipment	80,000
Miscellaneous	20,000
Component total	242,000

Common expenses

Administrative support to RNAM/ESCAP office	30,000
Travel non-UNIDO staff	40,000
UNIDO staff travel	20,000
Equipment for overall project support	10,000
Miscellaneous	20,000
Component total	120,000

Project total	US$	818,000

B. Western Samoa country projects

Country Project No. 1. Promotion and development of blacksmithing workshops.

Description of the subsector

The agro-related metalworking subsector of industry has a large potential, is relevant to the development of Western Samoa and is linked directly to the agricultural sector and the agro-based and food-processing industries. Local production of tools and implements used in the predominantly subsistence type of farming is an initial step towards the development of agriculture into a largely commercial and export-oriented one. Such tool and machinery production can be carried out by two or more small-scale metalworking enterprises which are to be developed along with other capabilities required to support a modernized and efficient agricultural production system although the desirable and ecologically sound features of the present farming system should be retained.

UNIDO has just updated the information on the status of the agro-related metalworking industry in Western Samoa under Phase I of the project Promotion and Development of the Agro-related Metalworking Industries in Least Developed Countries in Asia and the Pacific. A brief account of this industrial subsector is discussed below, along with the relevant information on the Samoan agricultural production system as the agricultural tool production industry, if it were to produce appropriate tools and machinery, would depend largely on the agricultural situation and farming system being practiced as well as on the future plans of the government regarding its development.

Except for two types of hand tools, namely the taro hole digger or "oso" and the coconut meat scraper or grater, virtually all agricultural tools and machinery are imported from New Zealand, Australia, U.K., U.S., Japan and Germany. It is notable that none is imported from any developing country, like that in Asia where the climate and soil conditions as well as the kind of crop grown are similar to those prevailing in Western Samoa and where more appropriate tools and machinery are likely to have been developed. The tools and machinery currently sold in the market have been introduced mainly on the basis of commercial decisions as there has been no institution which could have undertaken testing and evaluation of such tools and machinery. Moreover, the importation of such tools and machinery has been mainly done by a single and government-owned enterprise, the Agriculture Store Corporation (ASC) and to some extent by two other hardware stores. Due to a limited market and to take advantage of bulk purchase discounts, selection has been limited to a limited few, if not to only one design and make of tool or machinery. Thus, farmers, faced with no alternative choices, are constrained to buy whatever is offered by the corporation and the other distributors.

The following are the tools and machinery currently sold by ASC and by two hardware stores in Apia:

(a) Hand tools - straight-edged bush knife, oso, oso points, hoe, shovel, banana desuckering tool, spade, spading fork, rake, ax, pick ax, herbicide applicator stick, coconut meat scraper or grater, knapsack sprayer, trowel, pruning shears, fence wire stretcher, sprinkler and wheelbarrow.

(b) Engine-powered hand tools - mist blower, duster, chain saw, brush cutter and mower.

(c) Engine-powered machines - power tiller, electric generator and engine-pumpset.

There is potential for blacksmithing as some of the above hand tools, like the bush knife, oso, coconut grater, hoe head, ax head, rake and trowel can be made from scrap high carbon steel such as vehicle leaf springs which are readily available. Wood charcoal and coconut charcoal could be made readily available as dead trees in the aftermath of three consecutive years of hurricanes are abundant. Coconut and cocoa production are still recovering from the devastating effects of such hurricanes which hit the country in 1990, 1991 and 1992. The taro plantations have been almost wiped out by a blight disease which started in December 1993.

Human resources in metalworking technologies are trained at the Western Samoa Polytechnic (WSP) which has satisfactory training facilities and qualified instructors in this field. The curriculum is linked with the industry through the President of the Chamber of Commerce who is a member of WSP's Board of Management.

Policies and strategies

There is no specific policy or strategy for the manufacture of agricultural tools and machinery nor their usage by farmers. However, there had been a project during the late 1960s and supported by FAO on the lease of agricultural tractors and machinery to farmers. This scheme was not sustained by the government after the support was withdrawn. Currently, ASC is leasing sprayers and other powered equipment to farmers towards their eventual ownership of the machines. These activities indicate the positive attitude of the government towards mechanization as labour is not readily available and the cost of hired labour is high.

Neither the Department of Trade, Commerce and Industry nor the Department of Agriculture, Forests and Fisheries (DAFF) has immediate plans to formulate any policies, unless perhaps stimulated by the implementation of a project on the promotion and development of agro-related metalworking industry. Currently, the industry is therefore, left for the private sector to develop. Except for the sales and lease arrangement of tools and machinery to farmers by ASC, the government does not involve itself in the promotion or extension of tools and implements. ASC has leased its machinery repair workshop to a private entrepreneur, perhaps as part of an unstated policy of privatisation of government-owned enterprises.

DAFF was actively involved in the FAO regional expert consultation on agricultural implements and tools of the South Pacific islands held in Apia during 21-24 September 1992. It has shown keen interest in the agro-related metalworking industry project and has indicated that it be the national focal point (NFP) for the project.

Improving tools and machinery for more efficient crop production

The simplest and perhaps the most widely used tool, as it is indispensable in farming, is the bush knife which is imported. The type currently used and is the only kind available has a straight edge. The design may be appropriate for clearing dense vegetation, waist high, as it originated as a jungle knife used by the army. However, it is currently used also for cutting creeping vines, grass and other low-lying weeds as well as for other cutting purposes for which the straight edge design is not as efficient as the curved blade, based on the experience of Asian farmers. The curved blade design of the knife can be made by blacksmithing.

One design of the locally made digging rod, locally called "oso", is reported as not durable because the soil engaging point is not hardened. Some locally made crowbars are made of mild steel which easily bends under ordinary use. A variant of the oso which is not available but is a versatile tool, is the one with a narrow width and flat blade which can be made by blacksmithing.

The productivity of grating or scraping coconut meat prior to extraction of the coconut cream or milk could be increased several times if the design of the scraper is changed from the current flat single-blade type to a rotary four-bladed type.

Harvesting of coconuts every 45-days coinciding with the maturity stage when oil and cream content is optimum will increase the oil yield per coconut. The present practice of harvesting the nuts after they fall naturally which means that they are dried and way past maturity results in high losses of oil or cream. A coconut harvesting tool and technology which is well-developed in the Philippines and other coconut-producing countries may be transferred to Western Samoa. The tool may be locally made by blacksmithing, a technology which is yet to be introduced.

Banana has temporarily replaced the taro as staple and export crop because of the devastation caused by blight disease on taro in late 1993. The tools which need to be improved are the desuckering tool and the knife used for separating the fruit cluster from the bunch stem without wounding some of the banana fingers. A flat blade oso can be a good digging tool for planting the banana suckers or corm pieces.

Peanut is getting popular due to its good stand and yield as found by farmers who pioneered in planting it. They are now looking for an efficient peanut planter and sooner or later they will be looking for an efficient row weeder, a peanut thresher and a peanut sheller.

The Western Samoa Farming Systems Project (WSFSP) being implemented by DAFF with assistance from the Australian International Assistance Bureau

(AIDAB) plans to introduce, through pilot demonstration growing, crops, such as pineapple, ginger, pepper and chili. The University of the South Pacific has successfully grown asparagus. The production of such vegetables and row crops need special hand tools, seeders and other machinery, the designs of which can be obtained from other countries such as those participating in the Regional Network for Agricultural Machinery (RNAM) being implemented by ESCAP in Bangkok.

Farming is expected to get more and more intensified as farmers discover the more efficient methods, tools, machinery and technology coupled with prospects of high income, especially from the high-valued and export crops. Volcanic rocks which are found strewn all over the two Samoan islands will be cleared in due course depriving the thin soil of protective barrier against erosion caused by rainfall.

The change in farming system from the present practice of minimum or no tillage as in taro planting using only the oso, may cause environmental degradation and soil nutrient depletion unless technologies, like terracing and strip cropping along contours are practiced. With these technologies appropriate tools and machinery will be needed. For example, to make rock windrows along the contour lines, a rock picker or windrower will be needed as the hand-picking method is perhaps too tedious, laborious and discouraging for the Samoan farmer to do.

Weeding is perhaps the most laborious cultural practice which must be done if row crops or even trees will be grown. More efficient eradication of weeds will mean more exposure of the soil to rain and thus, greater likelihood of erosion than when there is grass cover or "bioskin". The introduction and popularization of modern farming practices should be accompanied by similar introduction of agricultural technologies or practices which will neutralize their deleterious effects.

Host country strategy

Western Samoa encourages the development of the private sector agro-based industries which are export-oriented and which will produce consumer goods to replace or compete with imported ones. The reduced remittances of foreign exchange by emigrants due to economic recession in Australia and New Zealand, has made the government to conserve foreign exchange through imposition of high tariffs on imported items. DAFF in particular, encourages replacing the imported tools and implements with locally produced and more suitable ones largely through the efforts of the private sector. For this, it has indicated willingness to provide the necessary institutional support. While the government does not particularly restrict the farmers to follow certain mechanization systems, it is seriously concerned with the use of highly toxic herbicides for weed control.

Serious and hard efforts are to be made to convince farmers to use draft cattle for transport using carts or for field operations using ploughs and harrows. Transportation costs will get more and more expensive and alternative ways, such as animal draft for farm transport may be a possible strategy. In this regard, the metalworking industry may respond by providing the fabrication services.

Projects and ongoing programmes

1. Regional Network for Agricultural Machinery (RNAM)

This project of 11 Asian countries has its headquarters at ESCAP in Bangkok, Thailand. One of its activities is to gather information on machinery designs and mechanization experiences from various sources and disseminate it to the member countries. It promotes TCDC/ECDC in which one of the activities is the holding of regional exhibitions and symposiums, called Agrimach, the latest of which was held in Jakarta, Indonesia in December 1993. The project on promotion and development of agro-related metalworking industry in Western Samoa may link with RNAM and be benefitted by its database on agricultural machinery and mechanization.

2. The University of the South Pacific (USP)

The main campus of USP is in Fiji but its School of Agriculture is located at the Alafua Campus in Apia, Western Samoa which is linked with the other Pacific countries through an efficient communication system. Its agricultural engineering section offers courses in soil and water engineering, structures and agricultural power and machinery, including selection and use of equipment adapted from other countries. USP has also the Institute for Research, Extension and Training in Agriculture (IRETA) at the Alafua campus and operates three experimental, production and training farms.

Some of the machines, like the hand lever-operated peanut sheller, solar drier, seeder, root chipper, rolling injection planter and seed jabber adapted from Southeast Asian countries, are rarely, if ever, shown to farmers. Nevertheless, graduates get first-hand experience regarding design and can therefore, initiate the development and introduction of agricultural machinery in their respective countries. However it is hoped that the Pacific Network for Agricultural Tools and Implements (PACNATI) will enable the dissemination activities to occur. In Western Samoa, this has not resulted in the establishment of a new metalworking industry based on such experiences. One of the reasons is the lack of a metalworking industry in both the public and private sectors. Therefore, as a first step, promotion and development activities for such industry with institutional support is needed both in the industry and the agriculture sectors.

3. Pacific Network for Agricultural Tools and Implements (PACNATI)

The FAO Regional Expert Consultation on Agricultural Implements and Tools of the South Pacific Islands, held during 21-24 September 1992 at UPS/IRETA proposed the establishment of PACNATI. The objective of PACNATI is to "contribute to improving and promoting agricultural tools, implements by way of better research and development, production promotion and marketing". Its operational activities parallel those of RNAM in as far as exchange of information among the participating countries is concerned. However, rice production machinery which are common to RNAM participating countries are not normally used in most PACNATI participating countries.

The cooperation of USP to provide secretarial services to PACNATI has been agreed upon. The FAO Regional Agricultural Engineering and Agro-industries Officer is to act as liaison officer, especially with ESCAP/RNAM. Although no membership fees will be charged, the member countries will be expected to allocate some local funds to facilitate activities of PACNATI, particularly those which are in the spirit of TCDC. The actual establishment of PACNATI is still in process, mainly through the efforts of UPS. Concurrence to the draft document by the various countries concerned are still in the process of being followed up with the governments through the FAO country offices. Cooperation of USP, the South Pacific Commission and the Technical Centre for Agriculture and Rural Co-operation (CTA) with PACNATI is being obtained if not already done so.

4. Western Samoa Farming Systems Project (WSFSP)

This project started by in February 1993 by AIDAB, in co-operation with DAFF. The aim of the project is to create rural opportunity and income in Western Samoa by improving and sustaining farm productivity levels of rural households as well as developing economically viable crops in ecologically suitable and sustainable farming systems for production by the Western Samoan farming family.

Institutional framework

DAFF is the national focal point for the project. It is most concerned about the lack of local capabilities in the production of a tool as basic and simple as the bush knife. Among its three stations, the one at Nafanua appears to have the largest potential for having a pilot metalworking shop in view of its proximity to DAFF and to some of the metalworking enterprises with which the workshop would have close contact. However, the workshop is only a building and blacksmithing and fabrication tools have to be provided. Moreover, it still has to be provided with suitable staff consisting of an agricultural engineer and at least three technicians competent in fabrication and machining work, if it has to relate effectively with the project.

DAFF can closely collaborate with the WSP which offers vocational courses of which mechanical fitting and machining, welding and sheet metalworking have relevance to the project. WSP has excellent facilities and three competent instructors

in this area who can assist DAFF in the fabrication and testing of machinery prototypes.

DAFF implements the WSFSP which has components, namely farming systems development, production of improved planting materials, processing and marketing, target beneficiaries, community participation and project management. These components have particular bearing on tools and machinery development and promotion of agro-related metalworking industry.

Problem to be addressed and present situation

Phase I of the regional project on promotion and development of agro-related metalworking industries in least developed countries (US/RAS/92/072) was carried out for Western Samoa during the visit to the country of the UNIDO expert from 5 to 18 January 1994. The development objective of the project was to establish appropriate policies/programmes in the Asian and Pacific LDCs for strengthening the agro-related metalworking sector, thereby enabling the sector to meet the demand more efficiently.

One of the immediate objectives was to increase the awareness and access of agro-related metalworking enterprises to technical information and advice through strengthened NFPs and their links with existing networks, including RNAM and other potential sources of technology. DAFF was identified as the NFP of Western Samoa. Through the NFP, the project was able to establish new and strengthen old linkages with relevant private and public sector enterprises and institutions whose current and future activities would lead to the promotion and development of agro-related metalworking industries.

The following are the identified problems regarding the above institutional framework:

(a) DAFF has no agricultural nor mechanical engineer on the staff as it does not have an agricultural engineering unit.

(b) DAFF has no posts for three technicians for staffing a workshop needed for the research and development work. It's human resources are for vehicle repair workshops and their experience is limited to motor vehicle repair and maintenance.

(c) The few metalworking shops existing in the country fabricate and repair machines which are non-agricultural in nature. They do not have experience in fabricating agro-related tools and machinery nor are familiar with their functions. Their machine tools are still inadequate and their human resources need training and more experience. This is not surprising because the metalworking industry itself is just starting.

(d) The only institution which provides vocational training is WSP. Although fitting, machining, welding and sheet metalworking courses are being offered, the graduates would still need exposure or practical experience in a commercial or production workshop before they can truly have confidence in integrating their knowledge towards building functional and good quality machines.

(e) Bank loans for capital investments are limited by the value of security being proposed. A maximum of WS$5,000 may be borrowed without collateral from the Development Bank of Western Samoa (DBWS). However, a guarantor is required.

The problems associated with changes in the current agricultural practices are as follows:

(a) The fields are generally rocky, both in the Upolu and the Savaii islands. Thus, use of tractors or power tillers is limited and can be feasible only if the fields have been cleared of such obstructions. The traditional manual method of planting taro by means of a hand jabbing tool or oso is considered to be an ecologically sound cultural practice.

A new tillage technology such as the practice of the mechanized tillage system will bring about erosion and soil degradation problems as the soil is volcanic and thin. To avoid such problems, soil conservation techniques, like contour strip cropping and terracing will have to be applied. Massive extension work will be needed.

The effects of wide use of herbicides have not yet been appraised. Should the effects on the surface and ground waters be found detrimental to the environment, the withdrawal of the system might be difficult. In the case of mechanized tillage systems, the soil degradation due to erosion will be irreversible.

(b) Massive extension work is also needed in promoting the cultivation of new crops such as those intended to be introduced by WSFSP. An environment friendly tillage and cultivation system for the fragile ecological conditions in Western Samoa is needed to be developed. The research and development capabilities in this agricultural engineering area is lacking as there is no agricultural engineer nor at least an agriculturist with an engineering background in the DAFF organization to look into such problems. Yet appropriate tools and machinery are required to successfully introduce new crops to farmers.

Expected end-of-project situation

At the end of the project, the following will have been achieved:

(a) Three trainers from WSP will have been provided fellowships for developing skills in blacksmithing and will have conducted demonstrations in strategic

and remote villages in Upolu and Savaii islands to promote the establishment of smithies (blacksmithing workshops) by village entrepreneurs.

(b) Interested village entrepreneurs from remote villages will have been trained in blacksmithing at the blacksmithing pilot and demonstration foundry at WSP.

(c) At least five blacksmiths trained at WSP will have established their own smithies in Upolu and Savaii and will have produced improved hand tools introduced by the project.

(d) DAFF will have developed the capability to coordinate the activities of the trainers in blacksmithing with those of WSFSP which will have specified the types of tools needed for the promotion of crops and farming systems.

(e) DAFF will have coordinated with WSP in organizing blacksmithing training courses for interested village entrepreneurs; will have provided assistance to such entrepreneurs in securing loans for buying blacksmithing equipment through the establishment of a loan guarantee fund in collaboration with the Development Bank of Western Samoa.

(f) DAFF will have established a system of monitoring and evaluation of the activities of the smithies established through assistance of the project. It will also have a continuing assistance programme to the blacksmiths through supply of information on new tool designs which will have been obtained through relevant projects of DAFF (e.g., WSFSP), RNAM and possibly, PACNATI or USP.

Target beneficiaries

Target beneficiaries will be the small-scale or cottage industry entrepreneurs or craftsmen in the villages of Western Samoa. Farmers and villagers who will be supplied with the locally made tools, expected at lower cost, easily repaired and more appropriate to their needs than the imported ones, will be also benefitted.

The potential entrepreneurs in blacksmithing will be given special training at WSP and will be provided further assistance in establishing their own smithies through technical advice, preparation of loan proposals, provision of loan guarantee fund and promotion of blacksmithing products (through DAFF/ASC). The blacksmiths will have monetary income from the small-scale or cottage-type metalworking industry which will geater to the requirements of their own villages but also of the neighbouring villages. As it has been in most developing countries in Asia, blacksmithing technology which will be acquired with assistance from the project, will be handed down to the next generation and therefore, the benefits will be far-reaching and lasting.

Some staff of the participating institutions will also be benefitted through fellowships in group training programmes.

Smallholders or farmers owning small parcels of land will benefit from the project because of the consequent extension activities in promoting improved tools and machinery. Blacksmiths will be the focal points of DAFF in the villages when doing extension work on agricultural technologies.

Since the farming activities are taken up mostly by women, the tools which could be provided by blacksmiths will be of great value to them. Women who traditionally take a large share of farming activities will be eased of their burden through the use of improved tools suited for their physique and even custom-made for them by village blacksmiths, resulting in greater productivity, efficiency of operations and increased income.

Project strategy and institutional arrangements

The project strategy is designed to create new small-scale agro-related metalworking industries, particularly blacksmithing shops in selected villages. The Director and Deputy Director of DAFF as well as the other senior staff, are committed to the sustainability of the project.

The Credit Guarantee Scheme will be established by DAFF with assistance from the project in collaboration with the existing credit institutions in Western Samoa to provide partial guarantees for loans to qualified Western Samoan entrepreneurs. DAFF will streamline the procedures for nomination of qualified entrepreneurs as well as the subsequent extension service during the investment and operational phase of such projects.

DAFF will be the focal point of this new project which focuses on promotion of blacksmithing in Western Samoa. A short term consultant will be provided to work with DAFF. The Director of DAFF will be designated as the national project coordinator. Other departments will also be involved, as appropriate, in the implementation of the industrial development project. The agricultural extension unit of DAFF which is directly involved in WSESP will play a crucial role in the promotion of tools integrated with the relevant agricultural technology. Marketing of the tools in Apia will be done through ASC which is under the administration of DAFF.

The trainers in blacksmithing will be specifically assisted by an Associate Expert. Significant domestic travel will be required for the project staff to assist the institutional capacity development of DAFF. Initial technical assistance will be provided by a consultant to train trainers in the area of blacksmithing fundamentals. Consultant services will include a blacksmithing expert for one month, in collaboration with FAO.

The project will focus on the development of blacksmithing in the villages where agricultural tools have large potential due to difficult supply of imported hand tools.

Three mobile or roving pilot and demonstration smithies or blacksmithing

workshops will be established to promote the industry in the targeted villages. Each workshop will be operated by a blacksmith trainer who will have been trained abroad for three months under a "master village blacksmith" identified with assistance of the National Institute of RNAM in the country. These three blacksmiths will eventually be trainers of village blacksmiths at WSP in Apia. They will initially be conducting demonstrations in Apia, then in the villages.

The attraction of blacksmithing in the village is expected to create awareness of the technology and the hand tool products which may substitute the imported ones. Farmers and users, including women, can give their suggestions for improving each tool which can actually be made to order. After demonstrating in a village the trainer will invite trials and identify those who show aptitude or native talent in the art, interest and ability to invest in a blacksmithing equipment set and workshop. The selected candidate in the will be invited for training at the pilot and demonstration smithy at WSP. Quality control will be instilled in the mind of each trainee.

Equipment to be provided are as follows: one motorized tricycles (motorcycles with side-cars) for the Associate Expert. At Apia a pick-up truck will be provided for use by the expert and the project staff.

Reasons for assistance by UNIDO

The implementation of Phase I of the UNIDO assisted project on promotion and development of agro related metalworking industries is the latest in a series of activities undertaken by UNIDO to fulfill the desire of the least developed countries themselves to develop capabilities in this area. Major initial actions consisted of organizing and preparing a report on a regional workshop on the subject and the preparation of the document on country briefs regarding the status of agro-related metalworking industries. UNIDO has taken steps to integrate the development efforts for the industry with the agricultural practices and development plans in each country. The agro-related metalworking industry directly supports agricultural development and yet would depend on the degree of such development for the market of tools and machinery. Having prepared the concrete groundwork with emphasis on the industry sector, UNIDO should continue to be the source of technical expertise on the subject.

Special considerations

The project promotes technical and economic co operation among developing countries and addresses the particular problems in Western Samoa. The introduction of modern tools and machinery will benefit women and in most cases, children who invariably do most of the field work. For example, the introduction of a wheeled load-carrying device for transporting coconuts would not only ease their burden but would also increase their productivity. Such a change may even indirectly cause the empowering of women with sales money and thus contribute to the social uplifting and improved living standards.

Coordination agreements

The NFP or DAFF will play an active role in the implementation of activities of the project. The project secretariat, joint operation of UNIDO and ESCAP/RNAM, will maintain contact with DAFF and USP School of Agriculture and, in particular, the Agricultural Engineering Section as well as IRETA. The executing agency, UNIDO, will co-ordinate and consult whenever necessary.

DAFF will utilize its workshop which shall be developed through the assistance of the project. It will work closely with the private metalworking enterprises as well as with USP Agricultural Engineering and IRETA in the design, fabrication, testing of agricultural machinery and utilize its extension services in the promotion of new machines to farmers. For the latter, co-ordination will be made with the WSFSP which DAFF itself is implementing.

Counterpart support capacity

DAFF recognizes the great need for developing capabilities in the local manufacture by the private sector of tools and machinery to improve the agricultural cultural practices and hence production. It played an active role in the FAO regional expert consultation on agricultural implements and tools of the South Pacific Islands held in Apia in 1992 and supported the work of the UNIDO expert under Phase I of the project, Promotion and Development of Agro-related Metalworking Industries in Least Developed Countries (US/RAS/92/072).

DAFF has indicated to make efforts to allocate local resources for the organization of an agricultural engineering section at DAFF not only for the project but also to provide continuing activities and follow-up actions after the project life itself. While the section is essential it is not an absolute necessity for implementing the project. In view of the financial constraints being faced by the Government, the formation of such section will be held in abeyance. In the meantime, DAFF will get the cooperation of WSP to provide the technical support in the mechanical aspects of the project, particularly the training of village blacksmiths.

WSP has indicated its full cooperation to the project by allocating human resources for developing trainers in blacksmithing. It will also allow the use of its facilities for setting up a pilot and demonstration smithy, training of blacksmiths and as a blacksmithing enterprise incubator.

DAFF can provide extension staff to oversee activities of training of blacksmiths in the villages and provide information on the types of tools needed for the production of crops being introduced by WSFSP.

Development objective

The development objective is to establish policies and programmes for strengthening the agro-related metalworking industry sector, thereby enabling the sector to meet the demand more efficiently than it can at present and to provide the machinery input support to agriculture towards sustained production of food and raw materials for agro-based industries.

Immediate objectives

1. Immediate objective 1

To develop and strengthen the capabilities of DAFF, in collaboration with WSP, in providing technical and institutional support in the promotion and development of the blacksmithing industry in Western Samoa.

1.1. Output 1

Three trainers of blacksmiths from DAFF acquired knowledge and skills in blacksmithing as well as know-how in replicating proven agricultural hand tools after having been trained each under a "master blacksmith" in a developing country in Asia and also became capable of organizing and conducting effective demonstrations and training courses in blacksmithing.

Activities for output 1

1.1.1. Establish a pilot and demonstration blacksmithing workshop consisting of four sets of equipment, one permanent and three roving, at WSP in Apia.

1.1.2. Organize, in collaboration with FAO, a one-month basic training programme in blacksmithing with technical assistance of a consultant, for interested persons at WSP, three of whom will be selected for fellowship training in advanced blacksmithing in other countries.

1.1.3. Select from among the participants in the course, three most qualified trainees from WSP who will be committed to organize and conduct demonstrations and training in blacksmithing in the villages. They will be given fellowships for advanced and practical course as indicated in Activity 1.1.4.

1.1.4. Organize also, in collaboration with RNAM and through the National Institutes of the RNAM, three separate 3-month advanced and practical training programmes in blacksmithing, one each in India, the Philippines and Thailand. Each trainee will receive practical experience on-the-job under a developing country setting and under the supervision of a "master blacksmith" who is engaged in the production of agricultural hand tools intended to be introduced to Western Samoa. Thus, the trainee is expected to learn producing the common and popular tools in the country. The training programme will include also learning sessions in demonstration techniques and development of communication skills. It will also include local study

tours to observe and learn about farming practices in the host country, especially those needing the use of hand tools and animal-drawn implements which each trainee encounters in the blacksmithing practice. Examples are observations of the coconut harvesting and processing system and the use of animal-drawn implements and carts which may be adapted in Western Samoa through provision of blacksmith's products. These sessions will be arranged by the National Institute of RNAM in the country.

1.1.5. Immediately after the return of the trained trainers in blacksmithing to Western Samoa, organize and conduct a two-week workshop by the trained blacksmiths at WSP, for the purpose of:

(a) Debriefing the DAFF and project staff;

(b) Exchanging among themselves (trainers), the experiences gained and the designs of tools acquired from their respective countries of training;

(c) Fabricating samples of such designs for exhibits and for home trials and demonstrations by selected government officials and other persons (Activity 1.1.6.);

(d) Training the trainers further in effective training, communication and demonstration; and

(e) Preparing questionnaires, posters, leaflets and other information materials.

1.1.6. Organize a seminar with demonstration by the three blacksmith trainers before invited officials from DAFF, Department of Commerce, Trade and Industry, Western Samoa Manufacturers Association, farmers groups and other relevant organizations. Distribute tool samples for field trials and get feedback, including suggestions for improvement of the tools, through questionnaires about performance and acceptability. Use the most favoured designs of tools in subsequent introduction during the local training sessions.

1.2. Output 2

Three roving pilot and demonstration blacksmithing workshops established; demonstrations of blacksmithing works covered at least 20 villages in Upolu and 10 villages in Savaii islands. Sample tools tried by some villagers; questionnaires on reactions to the tools given, recovered, analyzed and suggestions considered.

Activities for Output 2

1.2.1. Organize and launch a public demonstration on blacksmithing at the public market in Apia. Preparatory activities will include, but not limited to, the following:

(a) Announcement of the event over the radio, newspapers and by

means of posters wherein the public is invited to bring damaged or worn out bush knives or other tools and small pieces of scrap hard steel (e.g. leaf springs of motor vehicles) for possible repair, recycling into another tool or making into a tool;

(b) Preparation of leaflets on investment opportunities in blacksmithing in the villages to supply tools locally and possibly for export to other South Pacific Islands, if good quality is attained and maintained; and

(c) Making of samples for sale at the demonstration with attached questionnaire regarding their reactions to the tools for the purpose of improving the quality.

1.2.2. Continue the demonstration and sales/services up to a designated period. Then, each blacksmithing unit will move separately to the villages with a view to demonstrating and covering strategically located villages, at least 20 in Upolu and at least 10 in Savaii.

2. Immediate objective 2

To promote the establishment of smithies in the villages to supply the local hand tools.

2.1. Output 1

At least two smithies established by private entrepreneurs in villages where they are considered to be viable; such workshops engaged in the commercial production of tools introduced by the project through WSP.

Activities for Output 1

2.1.1. Organize at the pilot and demonstration smithy at WSP, practical training courses in blacksmithing for interested village entrepreneurs. Training will essentially be conducted by the three trained trainers who have identified potential trainees during their demonstrations in the villages.

2.1.2. Assist each identified entrepreneur in establishing a smithy by specifying equipment; helping in the procuring the equipment; advising on the operation of a smithy; giving training through the trained blacksmith trainers and making available the facilities of the WSP pilot and demonstration smithy for agro-related metalworking industry incubator.

2.1.3. Assist blacksmithing entrepreneurs in obtaining financing of equipment and initial operational capital from DBWS, commercial banks, credit unions, government programmes and grants-in-aid schemes
through DAFF.

2.1.4. Monitor the performance of the blacksmiths through visits and assist them further through providing improved tool samples, catalogues of hand tools and ad-hoc technical advice, particularly on quality control. Evaluate the results and document the significant events for use in further promotion programmes.

Inputs

Government inputs in kind

1. Counterparts

(a) Three counterparts will be provided for the Agricultural Machinery Adviser - the Director of DAFF and two agricultural extension staff involved in the Western Samoa Farming Systems Project. The Government, and in particular, WSP will provide qualified trainees for training trainers in blacksmithing who will be committed to be trainers and counterparts of the Agricultural Machinery Adviser after having been trained through project fellowships. One counterpart will be provided for the Associate Expert. The Government will pay the salaries and allowances for official travels of the counterparts.

(b) In addition to the above, DAFF will provide an assistant to the blacksmith trainer during his training tour in key villages. Salaries and per diem will be provided to the trainer and his assistant.

2. Secretarial support

The project will have access to the DAFF's typist for all typing and secretarial work.

3. Office Space and facilities

Office space and facilities will be provided by DAFF and WSP for the technical advisers and experts. Workshop space will be provided by WSP for the pilot and demonstration foundry which will serve also as the training and incubator facility for blacksmithing.

4. Transport

Transportation costs will be provided for the project personnel in official travel to the villages.

5. Training

DAFF will provide funds for the seminars and demonstrations as well as the logistics for training in blacksmithing in the villages.

UNIDO inputs

Agricultural Machinery Adviser, 6 w/m, (3+3)	US$	78,000
Associate Expert in metalworking, with knowledge of blacksmithing technology, 12 w/m		Nil

Three fellowships for practical skills training in blacksmithing under practicing "master village blacksmiths",3 months each		30,000

(i) One fellowship in India;
(ii) One fellowship in Philippines and
(iii) One fellowship in Thailand.

(Note: The training of trainers of blacksmiths is one of the immediate objectives of the proposed regional project of which Western Samoa is a country participant. The activities and approach for the country project are different from those of the regional project).

Blacksmithing equipment		15,000
Agricultural hand tools		4,000
Motor vehicles (i) One pick-up truck with double cab, 4-wheel drive (ii) Two units motorized tricycles for provincial trainers of blacksmithing		21,000
UNIDO Misson costs		8,000
Miscellaneous		10,000
Project total	**US$**	**171,000**

Country Project No. 2. Promotion of local fabrication of agricultural production and processing machinery.

Description of the subsector

See Country Project No. 1.

Institutional framework

See Country Project No.1, Institutional framework.

DAFF can also collaborate with USP regarding the provision of technical or engineering support in design of machinery. The USP School of Agriculture, Agricultural Engineering Section has agricultural engineers and workshop facilities for instruction and machinery development activities. It has also a graduate research assistant, a Samoan national, who may be assigned to work on special problems in machinery development involved in the project. This will make his graduate work relevant to the situation in Western Samoa. The staff agricultural engineer of USP may also be involved in the project through giving technical assistance and as member of the agro-related metalworking industry technical support services team (AMITSST).

Problem to be addressed and present situation

See Country Project No. 1.

Expected end-of-project situation

At the end of the project, the following will have been achieved:

1. At least two existing private metalworking industries in Upolu will have been actively engaged in fabricating and supplying agricultural machines introduced by the project and identified as needed for producing or processing crops recommended by MAL.

2. MCET/IDD, the national focal point of the project, will have been strengthened further through its activities in promoting, developing, evaluating and monitoring the agro-related metalworking industry.

3. AMITSST, the mechanism for involving the trained technicians in rendering technical services to private metalworkshops in fabrication of coconut processing and other machinery will have been active.

4. DAFF will have established close collaboration and linkages with WSP and USP.

Target beneficiaries

Target beneficiaries will be the small-scale metalworking entrepreneurs in Western Samoa. Farmers and villagers who raise coconuts will also be benefitted because of the production and processing machines which will be made available to them at least for hire or custom operation, if they do not have the capability to own the machines themselves. There will be greater value adding especially in the case of coconuts which can be processed for oil right in the villages. Women will be especially benefitted by carrying products of higher value per unit weight or volume than in the case of raw coconuts. Ultimately, with increased productivity and improved efficiency of operations, the society as a whole will be benefitted.

Two technicians from the private metalworkshops will be provided training to enable them to produce machines and to serve in the AMITSST.

Smallholders or farmers owning small parcels of land will benefit from the project because of the consequent extension activities in promoting improved tools and machinery.

Increased production of other crops will be promoted because of the availability of machinery suited for smallholder operation.

Project strategy and institutional arrangements

The project strategy is designed to encourage existing small-scale metalworking industries to diversify into fabrication of agro-related machinery while strengthening further the institutional capacity in the Government of Western Samoa, through DAFF. It will coordinate and provide technical advisory services and training to existing entrepreneurs who are interested in participating in the project activities.

DAFF will be the focal point of the project. A short-term consultant will be provided to work with the department. The Director of DAFF will be designated as the national project coordinator. Other departments will also be involved, as appropriate, in the implementation of the industrial development project.

Technical assistance will be provided by experts to train entrepreneurs or their workshop supervisors in the fabrication of specific machines. It will include an agricultural machinery fabrication expert for a total of 6 w/m with broken duty durations of 3 months each. An Associate expert will also be posted for one year.

The project will focus on the development of small-scale agro-related metalworking industries in the provinces where agricultural machinery have large potential as indicated by the feasibility of commercial, that is, beyond subsistence level, production of crops to be promoted by DAFF and WSFSP.

Diversified production of agricultural machinery by metalworking industries

The demand for certain types of machinery yet to be promoted in conjunction with the production of crops targeted by DAFF will be small. A machine, financed by a custom/hire service entrepreneur (also to be promoted by DAFF) may serve a group of villages producing a certain crop, e.g. peanut, in large quantities. Existing metalworking workshop entrepreneurs/supervisors will be trained to fabricate machines which are likely to be needed based on the popularity of certain crops, including those being promoted by DAFF and WSFSP.

The availability of machines for the production and processing of such agricultural products will induce their production as demand for processed products either for domestic consumption, import substitution and export will increase. For example, further processing of peanuts will need shellers, roasters and grinders.

Identified workshops will be assisted by provision of prototypes to be copied, technical advice and training abroad of key supervisors or technicians.

The Director of DAFF and other senior Ministry staff are committed to the sustainability of the project.

Reasons for assistance by UNIDO

See Country Project No. 1.

Special considerations

See Country Project No. 1.

Coordination agreements

See Country Project No. 1.

Counterpart support capacity

See Country Project No. 1.

Development objective

The development objective is to establish policies and programmes for strengthening the agro related metalworking industry sector, thereby enabling the sector to meet the demand more efficiently than it can at present and to provide the machinery input support to agriculture towards sustained production of food and raw materials for agro-based industries.

Immediate objectives

1. Immediate objective 1

To develop and strengthen the capabilities of DAFF, such that, in collaboration with WSP and USP, it can provide technical and institutional support in the promotion and development of the agro-related metalworking industry, particularly the fabrication of machinery for agricultural production and agro-based processing industries.

1.1. Output 1

Three technical staff comprising one from USP (Samoan national) trained in design and fabrication of agricultural machinery and two fabrication workshop instructors from WSP trained in fabrication of small-scale oil expellers and filter presses in developing countries in Asia.

Activities for output 1

1.1.1. Organize the following practical or hands-on training courses in collaboration with the National Institute of RNAM in either Thailand or the Philippines.

(a) One training fellowship in design and fabrication of agro-related machinery, particularly copra chopper, coconut oil expeller and filter press, for a Samoan agricultural engineer from the USP, 12 months; and

(b) Two training fellowships in fabrication technology of small-scale coconut processing equipment (drier, copra chopper, oil expeller and filter press) for a fabrication workshop instructor from WSP, 3 months each.

1.1.2. In cooperation with USP/IRETA and Agricultural Engineering, WSP, Manufacturers' Association, Chamber of Commerce and farmers' groups, conduct demonstrations of harvesting of coconuts and transporting them in horse saddlebaskets with a view to popularizing the technologies and the fabrication of tools and implements demonstrated.

1.1.3. Establish a pilot and demonstration fabrication workshop at WSP to serve as agro-related metalworking industry incubator for the fabrication of oil expellers, filter presses and other components of the small-scale coconut oil production system.

1.2. Output 2

At least two metalworkshop cooperators fabricated coconut oil production machinery adapted from commercial units introduced by the project.

Activities for output 2

1.2.1. Promote the establishment of small-scale coconut oil processing plants through providing interested entrepreneurs the following:

(a) Technical advice on feasibility studies;

(b) Information on success cases of such enterprises in other coconut producing countries;

(c) Loan guarantee for starting the business; and

(d) Assurance of the availability of the required machinery from local metalworkshops.

1.2.2. Enlist qualified metalworkshops as project cooperators whereby they will be encouraged to accept fabrication orders for machinery by coconut processing entrepreneurs through providing them the following:

(a) Commercial units of the machines (on loan basis) to be replicated;

(b) Technical advice regarding the fabrication technology of the machines;

(c) Imported machine components (e.g., bearings, pulleys, sprockets and chains) if the machine is being fabricated for the first time in the country; and

(d) Access to workshop equipment at the pilot and demonstration fabrication workshop, to be established at WSP (Activity 1.1.3).

1.2.3. Provide ad-hoc and on-the-job technical advice and training to metalworkshop entrepreneur and workers on the fabrication of the coconut drier, copra chopper, oil expeller, filter press and other components of a coconut processing system based on prototypes furnished by the project for adaptation of design.

1.2.4. Advise the entrepreneur of the small-scale coconut processing plant on the installation, operation and maintenance of the machines fabricated by the metalworkshop cooperator.

1.2.5. By arrangement, ensure that the counterpart staff from the USP and WSP who have been trained through the project are actively involved in the technical assistance programme in the fabrication work together with the international experts. The purpose is to strengthen local capabilities and to ensure continuing local technical assistance to the metalworkshop industries after the end of the project or after the experts leave.

1.3. Output 3

Similar to output 2 but enterprises are for small-scale processing of other crops which may produced in large enough quantities and are economically viable to merit establishing the business. Some of the promising crops are sugarcane (hand-driven sugarcane crusher for juice production), cocoa (fermentation tank, drier and grinder for chocolate production), peanuts (animal-drawn furrower, seed planter, inter-row cultivator, thresher, drier, sheller, roaster and grinder for peanut butter production) and other crops which may be successfully introduced by WSFSP.

Activities for output 3

1.3.1. Promote the establishment of the agro-processing enterprises through advice on feasibility studies, technical assistance in production and processing and business management as well as assistance with loan guarantee fund and demonstrations of processes using the machines planned for introduction.

1.3.2. Assist the entrepreneur further through local sourcing of the machinery requirements by providing metalworkshop cooperators with the suitable machinery to be fabricated under technical assistance of the project. Once a metalworking shop has successfully produced a machine, subsequent technical assistance for the fabrication of the same machine will be minimal due to the experience already gained. Technical assistance may then concentrate on quality control and production cost reduction measures, including modifying the design and testing the new machine.

1.3.3. Repeat the process for other metalworkshops and for other sets of machinery in integrated or semi-integrated production and processing of crops in season. DAFF continually monitors the performance of the metalworkshops and the enterprises which patronized them for their supply of machinery. The technical staff at USP and WSP, particularly those who have undergone training and study tour through the project will be constantly involved in the fabrication processes together with the project experts and will provide continuity after the end of the project. By that time, through intensive promotion efforts to establish small-scale agro-based processing enterprises, the metalworking enterprises will have the experience and the knowledge in fabricating the required machinery and will likely develop further capabilities in fabricating new machines with minimal technical assistance.

1.3.4. Utilize the machinery prototypes introduced by the project for small-scale agro-based processing industry incubators to be located either at WSP. A machine may be pulled out from the workshop by arrangement with DAFF should an inexperienced metalworkshop wish to replicate it. In this case, the technical support staff from USP and WSP are expected to give technical assistance to the metalworkshop entrepreneur.

Inputs

Government inputs

1. Counterparts

(a) The Government, and in particular, DAFF, will commit some of its human resources (one senior extension officers).

(b) DAFF will arrange, through a memorandum of agreement, with WSP regarding the commitment of WSP's instructors in machining and fabrication to provide technical assistance and on-the-job training services to metalworkshop workers and entrepreneurs trying to fabricate machinery introduced by the project through DAFF. To upgrade their capabilities and make them appreciate the development objectives of the project, DAFF will initially ask WSP to nominate two instructors in machining and fabrication for fellowships for a 3-month training in fabrication of coconut processing equipment. DAFF is also expected to arrange with WSP to commit the two trained instructors to serve as members of the AMITSST which will be headed by a senior DAFF staff. In effect, the two WSP staff will also act as counterparts to the project.

(c) Similarly, DAFF will arrange with USP for one agricultural engineer, preferably a Samoan national, as counterpart to the project. This USP staff will be given a fellowship for a one year training in the design and fabrication of machines for the small-scale coconut oil production system, consisting of copra drier, copra chopper, oil expeller, oil filter press and storage tank. The trained engineer will also be committed by USP to be a member of the AMITSST after the study tour.

2. Secretarial support

The project will have access to the DAFF's typist for all typing and secretarial work.

3. Office space and facilities

Office space and facilities will be provided for the technical advisers (AMITSST) and experts.

4. Transport

Transport costs and per diems will be provided for the project personnel in official travels to the villages.

5. Seminars, training and national meetings

(a) DAFF will provide funds for the debriefing seminars and logistics for demonstrations, arrangements and other activities peripheral but otherwise essential to the project.

(b) DAFF will provide the logistics for local training of metalworking entrepreneurs in the fabrication of coconut processing machines.

UNIDO inputs

Expert in agricultural machinery design and fabrication, 6 w/m (split missions)	US$78,000
Associate Expert in machinery design and fabrication	Nil
One training fellowship in design and fabrication of agro-related machinery, especially coconut or peanut oil expeller and filter press, cocoa grinder, sugarcane crusher for juice production, peanut sheller and others, for a Samoan agricultural engineer from the USP, 12 months	21,000
Two training fellowships in fabrication technology of small-scale coconut oil processing equipment (oil expeller, filter press, coconut meat shredder, etc.) for a fabrication workshop instructor from WSP, 3 months each	21,000
Agricultural tools 5,500	
Workshop equipment	20,000
Power units (i) Single-cylinder engines, 8 -16 hp, 5 units (ii) Electric motors, 1- 5 kW, 2 units (iii) Portable electric generator, 3 kva, 2 units	15,000
Audio-visual and other equipment for machinery extension	18,000
One pick-up truck, 4-wheel drive	15,000
Expendable equipment	45,000
UNIDO mission costs	10,000
Miscellaneous	15,000
Project total	US$263,700

Country Project No. 3. Semi-assembly of motorized tricycles for rural transport and introduction of animal-drawn carts and implements along with a soil conservation farming system (joint project between UNIDO and FAO).

Description of the subsector

See Country Project No. 1.

Institutional framework

DAFF is the national focal point for the project. It is most concerned about the lack of local capabilities in the production of agricultural hand tools as basic as the bush knife. Among its three agricultural stations, the one at Nafanua appears to have the largest potential for having a pilot and demonstration metalworking shop in view of its proximity to DAFF and to some of the metalworking enterprises with which the workshop will have contact.

However, there is only an empty building space. Blacksmithing and fabrication shop tools will still have to be provided. Moreover, posts for an agricultural engineer and at least two technicians competent in fabrication and machining work will still have to be created and qualified persons need to be recruited. Unless the staff requirements of the workshop at the Nafanua Agricultural Station were permanently provided by DAFF, its establishment would not be viable.

DAFF however, can closely collaborate with WSP. which has excellent facilities and three competent instructors in fitting/machining and fabrication technologies. It can assist DAFF in the fabrication and testing of machinery prototypes.

WSP is also an ideal alternative site for the pilot and demonstration workshop, consisting of a smithy, fabrication workshop and a space for an agro-related metalworking industry incubator. The institution however, must provide a separate building for the workshop. The facility can always be used as a practice workshop for senior students.

DAFF implements the AIDAB-assisted WSFSP which has components, including farming systems development, production of improved planting materials, processing and marketing, target beneficiaries/ community participation and project management. Agricultural hand tools and machinery are needed to support the components. The promotion and development of the agro-related metalworking industry will therefore be relevant to the project or vice versa.

Problem to be addressed and present situation

See Country Project No. 1.

End-of-project situation

At the end of the project, the following will have been achieved:

(a) DAFF, the national focal point of the project, will have been strengthened further through its activities in promoting, developing, evaluating and monitoring the agro-related metalworking industry.

(b) At least two existing private metalworking industries in Upolu will have been actively engaged in fabricating and assembling motorized tricycles; in fabricating wheel and axle kits for ox-carts as well as in fabricating ox-drawn ploughs, harrows and inter-row cultivators.

(c) A pilot and demonstration village for cattle husbandry (PDVCH) will have been established and will have successfully achieved the following:

(i) Cattle husbandry adoption by the villagers following recommended rearing practices;

(ii) Use of ox-drawn carts and horses with saddlebaskets in a new coconut harvesting system; also use of such transport facilities in other activities requiring transport of commodities from the farm to the road head;

(iii) Use of ox-drawn ploughs, harrows and inter-row cultivators;

(iv) Use of tricycles as personnel carrier and for transport of small loads in the rural area; and

(v) Practice of soil conservation tillage system, including sloping agricultural land technology (SALT).

(d) At least two village craftsmen, one in PDVCH and another in some other village will have engaged in the fabrication of wooden cart bodies and assemble them into the wheel and axle kits which will have been fabricated or semi-assembled by metalworkshops in the capital towns.

(e) DAFF will have established close collaboration and linkages with WSP.

Target beneficiaries

Target beneficiaries will be the small-scale agro-related metalworking industry entrepreneurs as well as the farmers in Western Samoa. Farmers and villagers who will have access to the locally made animal-drawn carts and implements as well as to motorized tricycle transportation services at affordable costs will be benefitted. Since the farming activities, including transport of goods from the field to the house and then to the market, are taken up mostly by women, the improved transport facilities and the animal-drawn implements will be of great value to them.

Ultimately, with increased productivity and improved efficiency of operations, the society as a whole will be benefitted.

The change-over from hoe-tillage farming to animal-draft tillage farming is a quantum leap in tillage technology and will increase productivity and production capacity even as such change-over will prepare the farmers to yet greater efficiencies using mechanical power. The greatest benefit perhaps will be that soil conservation practices will be instilled from the start, thus, avoiding a situation wherein farmers will have to unlearn environment-damaging tillage practices as is necessary in most developing countries.

A technician from one private metalworking industry recommended by the Western Samoa Manufacturers Association (WSMA) will benefit from the group training programme and can apply the newly gained knowledge immediately upon returning to Western Samoa. A technical staff of WSP will also benefit from the same group training programme and will impart his new practical knowledge gained to the students taking courses in fabrication and welding aside from giving technical assistance to private metalworkshop enterprises.

Three staff from government institutions and one private metalworkshop enterprise recommended by WSMA will also benefit from the study tour and group training programme to be organized by the project. They are expected to multiply their knowledge by providing technical advisory services to metalworkshop entrepreneurs and workers through an institutional support mechanism to be implemented jointly by their respective institutions with DAFF.

The entrepreneurs cooperating in the project will be provided technical and catalytic assistance for start up of fabrication of machines or components for commercial distribution.

Smallholders or farmers owning small parcels of land will benefit from the project because of the consequent extension activities in promoting improved tools and implements. Such promotion will be combined with the agricultural extension work as the project would look at the demand side of the products of the agro-related metalworking industry as an integrated activity, that is, agriculture and industry.

Project strategy and institutional arrangements

The project strategy is designed to encourage existing and potential metalworking industry entrepreneurs to diversify into the fabrication of agro-related machinery. In this case, the machines are tricycles, ox-cart component kits and animal-drawn implements. DAFF will be responsible for establishing an improved and strengthened institutional capacity through effective coordination and provision of technical advisory services and training to prospective and existing entrepreneurs who are interested in participating in the project activities.

DAFF will be the focal point of the project. A short-term consultant will be provided to work with the Division. The Director of DAFF will be designated as the

national project co-ordinator. Other departments will also be involved, as appropriate, in the implementation of the industrial development projects.

DAFF, particularly the research, extension and training units will play a crucial role in the promotion of tools and implements integrated with the relevant agricultural technology.

The project will focus on the development of small-scale agro-related metalworking industries in the provinces where production of tricycles, animal-drawn implements and carts has large potential as indicated by the feasibility of commercial level production of crops promoted by DAFF and WSFSP.

Diversified production of agricultural machinery by metalworking industries

The demand for certain types of machinery yet to be promoted in conjunction with the production of crops targeted by DAFF and WSFSP will be small. A machine, financed by a custom/hire service entrepreneur (also to be promoted by DAFF) may serve a group of villages producing a certain crop in large quantities. Existing metalworking workshop entrepreneurs will be trained to fabricate tricycles, animal-drawn implements and ox-cart components.

Key supervisors or technicians of metalworkshops cooperating with the project will be assisted by provision of commercial machines to be copied, catalytic assistance for start-up operations and technical advice in fabricating them. For example, a technician may be trained in the production of some critically needed equipment, like animal-drawn implements, such as a steel mouldboard plough and a peg-tooth harrow. Farmers will easily be motivated in producing rice if such machinery are available to them.

The Director of DAFF and other senior staff are committed to the sustainability of the project.

Equipment will be provided for use at the Provincial level as follows: motorcycles/tricycles for the Associate Experts. At Apia equipment , including a pick-up truck will be provided for use by the expert and the project staff. Audio-visual equipment will also be provided for use in training and extension especially in the PDVCH.

Reasons for assistance by UNIDO/FAO

See Country Project No. 1.

Special considerations

The project promotes technical and economic co-operation among developing countries and addresses the particular problems in Western Samoa. The introduction of modern tools and machinery will benefit women and in most cases, children who invariably do most of the field work. For example, the introduction of a wheeled

load-carrying device for transporting coconuts would not only ease their burden but would also increase their productivity. Such a change may even indirectly cause the empowering of women with sales money and thus contribute to the social uplifting and improved living standards.

Coordination agreements

The NFP or DAFF will play an active role in the implementation of activities of the project. The project secretariat, joint operation of UNIDO and ESCAP/RNAM, will maintain contact with DAFF and USP School of Agriculture and, in particular, the Agricultural Engineering Section as well as IRETA. The executing agency, UNIDO, will co-ordinate and consult whenever necessary.

The activities requiring the promotion of cattle husbandry in preparation for an eventual introduction of animal-drawn carts and implements will be jointly undertaken with FAO.

DAFF will utilize its workshop which shall be developed through the assistance of the project. It will work closely with the private metalworking enterprises as well as with USP Agricultural Engineering and IRETA in the design, fabrication, testing of agricultural machinery and utilize its extension services in the promotion of new machines to farmers and agro-based processing industry entrepreneurs. For the latter, co-ordination will be made with the WSFSP which DAFF itself is implementing. Similarly, coordination will be made by DAFF with WSP.

Counterpart support capacity

See Country Project No. 1.

Development objective

The development objective is to establish policies and programmes for strengthening the agro-related metalworking industry sector, thereby enabling the sector to meet the demand more efficiently than it can at present and to provide the machinery input support to agriculture towards sustained production of food and raw materials for agro-based industries.

Immediate objectives

1. Immediate objective 1

To develop and strengthen the capabilities of DAFF, such that, in collaboration with WSP and USP, it can provide technical and institutional support in the promotion and development of the agro-related metalworking industry, particularly the semi-assembly of motorized tricycles for rural transport.

1.1. Output 1

Two technical instructors from WSP trained in the fabrication of motorized and pedal-driven tricycles, ox-drawn cart and implements as well as horse saddlebaskets and committed to be part of the agro-related metalworking industry technical support services team (AMITSST).

Activities for output 1

1.1.1. Organize, in collaboration with ESCAP/RNAM and the National Institute of RNAM in the Philippines, a 3-month practical training programme for two fabrication and welding trainees, one from WSP and another from a private metalworks enterprise, in fabrication of motorized tricycle, animal-drawn implements and ox-cart as well as horse saddlebaskets. Guidelines for the course are shown in Annex 1.

1.1.2. Conduct a debriefing session by the two trainees upon their return to Western Samoa and after their completion of the training course. Officials of DAFF, the Ministry of Commerce, Trade and Industry, the Ministry of Transportation, the Manufacturers' Association and the Chamber of Commerce and other persons concerned will be invited to the debriefing. The trainees will appraise them of the activities undertaken and lessons learned during the training course. The presentation will be aided with slides and video tapes. Commercial units of the tricycles which will be provided by the project will be demonstrated.

1.1.3. Organize, under DAFF, an agro-related metalworking industry technical support services team (AMITSST) comprising the two trained trainers (1.1. Output 1), the four study tour participants (3.1. Output 1) and other trained staff from the Ministry of Industry, Commerce and Trade. AMITSST will be an inter-agency core group for providing technical support to the agro-related metalworking industry as well as monitoring and evaluation their progress.

1.1.4. Monitor the activities of the trainers, evaluate the results and document the significant events using video and film pictures for use in further extension and promotion work.

2. Immediate objective 2

To promote the semi-assembly of motorized tricycles among metalworkshop entrepreneurs.

2.1. Output 1

At least two metalworkshops engaged in the semi-assembly of motorized tricycles with technical assistance from the project, particularly from AMITSST.

Activities for output 1

2.1.1. In consultation with the appropriate government body for licensing purposes, loan one of the project demonstration tricycles to an entrepreneur recommended by the Manufacturers' Association or the Chamber of Commerce for doing experimental or pilot transport hire business, initially around Apia and later, in selected villages remote from Apia. The purpose of such experiment is to popularize the tricycle as a utility vehicle and determine actual demand for tricycle transport services.

Encourage entrepreneurs to engage in the fabrication of tricycles through notices placed in the roving tricycle and in the print and broadcast media. Through a survey questionnaire to be distributed and retrieved by the tricycle operator, determine the demand for the transport services as well as the interest among entrepreneurs in the production of motorized tricycles.

Encourage also potential entrepreneurs to engage in the tricycle hire service business in the rural areas to make transport services affordable.

2.1.2. Following positive results of the survey (Activity 2.1.1), promote the semi-assembly of tricycles among interested entrepreneurs and existing metalworkshop enterprises by providing technical assistance in the following:

(a) Conducting feasibility studies;

(b) Managing a small business (bookkeeping, cost analysis,etc.);

(c) Preparing loan proposals; and

(d) Availing of loan guarantees from a scheme established for agro-related metalworking industries.

2.1.3. Provide technical assistance to entrepreneurs in the semi-assembly of tricycles through the AMITSST, utilizing particularly the services of the two trained trainers.

2.1.4. Monitor, through the AMITSST all related activities including buyers and users of tricycles to ensure high quality and safety standards as well as their proper operation and maintenance.

3. Immediate objective 3

To set the stage for introduction of animal-drawn carts and implements by creating awareness among the DAFF officials and other institutions concerned about the feasibility of cattle husbandry, including training of animals for draft work, and the need for simultaneously introducing environment friendly and ecologically sound farming systems with the modern line tillage, cultivation and clean culture (weed-free farming) using animal draft or mechanical power.

3.1. Output 1

Four technical staff comprising two senior extension officers from DAFF, one agricultural engineer from USP (Samoan national), one fabrication workshop instructor from WSP and one metalworking entrepreneur from the Manufacturers' Association, familiarized in and got appreciation of the systems of rural transport, animal-drawn implements and vehicles, machinery extension, SALT and coconut harvesting and processing, in Indonesia, the Philippines and Thailand.

Activities for output 1

3.1.1. Organize, in collaboration with ESCAP/RNAM and the respective National Institutes of RNAM in Indonesia, the Philippines and Thailand, a study tour with practical familiarisation training for the following purposes:

(i) To observe small-scale and backyard animal husbandry, viz. cattle breeding, milking, fattening and draft work training as well as home yoghurt making;

(ii) To study and get practical training soil conservation tillage, particularly, SALT, including strip cropping and alley farming;

(iii) To get practical training in ploughing, harrowing, cultivating and cart pulling using draft cattle;

(iv) To observe the coconut harvesting and processing system and get practical training in using coconut harvesting tools, portable coconut huskers, ox-carts, horse saddlebaskets for transporting coconuts and coconut driers;

(v) To observe the small-scale machinery fabrication industries, viz., semi-assembly of tricycles and their usage in the rural areas.as well as fabrication of animal-drawn ploughs, harrows, cultivators, carts and horse saddlebaskets and;

(vi) To observe agricultural technology extension programmes of the ministries/departments of agriculture and the agricultural machinery extension programmes of the National Institutes of RNAM.

There will be four fellowships to be granted to two senior extension staff of DAFF and one each to and agricultural engineer from USP, one fabrication technology instructor from WSP and one metalworking entrepreneur from the Manufacturers' Association.

3.1.2. Conduct a debriefing session by the participants upon their return to Western Samoa after completing their study tour and group training programme. Officials of DAFF, the Ministry of Commerce, Trade and Industry, the Ministry of Transportation, the Manufacturers' Association and the Chamber of Commerce and other persons concerned will be invited to the debriefing. The study tour participants will appraise them of the observations made and the lessons learned from their activities. The presentation will be aided with slides and video tapes combined with

actual demonstrations of the implements and vehicles of which commercial units will be provided by the project.

3.1.3. Involve the four participants in the study tour together with the two participants in the 3-month training in fabrication (1.1. Output 1) as members of the AMITSST. One of their initial assignments will be the promotion of semi-assembly of tricycles and introduction of improved farming systems, such as SALT and coconut harvesting with emphasis on developing capabilities for the local fabrication of tools, implements and machinery needed.

3.1.4. Monitor all relevant activities, evaluate the results and document using video and film pictures for use in further extension work.

3.2. Output 2

Pilot and demonstration village for cattle husbandry and sloping agriculture technology (PDVCH/SALT) established and most villagers adopted rearing of cattle based on recommended practices.

Activities for output 2

3.2.1. Establish, through DAFF and in cooperation with the village head, a PDVCH./SALT. General guidelines are shown in Annex 2.

3.2.2. Develop a strategy for the introduction of cattle husbandry and SALT in the pilot and demonstration village. With advice from an anthropologist, consider the cultural aspects of the village folks. For example, commitments of the elders or the head (matai) of the family clan (aiga) towards a sustained cattle breeding and training programme for draft work will be ensured first before proceeding with further activities. Confidence-building among the young farmers and big children will be conducted. They will be exposed to the recommended handling and caring for animals through training and demonstration sessions in the village and the school. Appreciation of cattle husbandry, particularly, sustaining breeding practices by resisting family pressure to have the breeders slaughtered for celebrations, will be instilled with the family folks.

3.2.3. Use audio-visual aids, practical exercises and other learning motivations in all the training sessions.

3.2.4. Gradually introduce approved practices in cattle husbandry, including animal nutritional and health care, provision of shelter and forage gathering and chopping. In the advanced stage, train owners how to breed cattle, milk the cows and utilize milk for cheese, butter and yoghurt making and the dung for composting or direct use as fertilizer. These products will serve as incentives which will minimize killing the breeder cows, rather than the other animals for celebration purposes, a common deterrent to sustainability of cattle breeding.

3.2.5. Monitor the activities, give ad-hoc technical advice and evaluate results. Document the significant events by videotapes and photographs for use in future extension work.

3.3 Output 3

At least ten per cent of the oxen in the PDVCH trained and used for pulling carts and tillage implements.

Activities for output 3

3.3.1. At the appropriate stage of development in the PDVCH, initially train the farmers in handling oxen to pull loads, such as small logs or banana trunks. The ox should be able to respond faithfully and quickly to its owner's voice commands and tethering rope signals. The members of the AMITSST, particularly those who have undertaken the study tour in Indonesia, the Philippines and Thailand, should be able to conduct the training.

3.3.2. For the advanced training and familiarisation, progressively hitch a peg-tooth harrow, a cart.and finally, a mouldboard plough to the animal. Since among the operations, learning how to plough is the most difficult lesson for both the farmer and the animal, perseverance is necessary. The rewards will be great after the ploughing operation has been mastered as the farming work will be less tedious than using the manual method. This is a quantum leap for increasing the cultivated area.

3.3.3. Continue the training to achieve or exceed the target of 10% of the oxen population as trained. However, the training should not be faster than the achievement of 3.4. Output 4 described below.

3.3.4. Introduce the system of harvesting coconuts at 45-day intervals using a harvesting tool, husking using a portable coconut husker and transporting using the ox-cart or horses with saddlebaskets. All of the tools used can be made by local metalworkshops.

3.3.5. Monitor, evaluate and document by videotape and photographs the training of the farmers and the animals for future use in extension work in other villages.

3.4. Output 4

100% of the farming areas in the PDVCH/SALT practiced SALT using terracing with rock bunds supplemented with vetiver grass rows for soil conservation, strip or alley cropping, hedgerow planting and other cultural practices which do not cause environmental degradation.

Activities for output 4

3.4.1. Promote the SALT farming system where applicable. Use slides and video in the training of farmers. Prepare demonstration areas to illustrate clearly the importance of soil conservation farming. In coordination with WSFSP, introduce the cash crops at PDVCH/SALT. Farmers can compare the results visually between the control and the demonstration areas.

3.4.2. Demonstrate the techniques for laying out contour lines using the A-frame or the transparent tubing filled with water. Contour bunds made of rocks collected from the contour strips (lot between two adjacent bunds) may be unified for the whole village to cover a wide area. Terraced lands offer a scenic view and other farmers may be attracted to follow the technique. In places where land property lines have yet to be demarcated, the rock bunds present ideal permanent markers. Contour strips automatically become land subdivisions suitable for allocation of family lots or for inheritance purposes.

3.4.3. Develop the techniques of collecting the rocks and stacking them up as bunds along contour lines marked by pegs. Since the contour intervals are usually 2 to 4 meters depending upon the slope, the transport distance of a rock will be at most two meters or half the contour interval. Wheelbarrows may be used. Demonstrate also the planting of vetiver grass for more effective soil conservation and of hedgerow crops for forage and other uses.

3.4.4. Test the commercial units of animal-drawn implements (steel mouldboard plough, peg-tooth narrow and inter-row cultivator) in the SALT operations.

3.4.5. Demonstrate and teach ploughing along the contour or parallel to the direction of the contour bund.

3.4.6. Monitor, evaluate and document by videotapes and photographs significant activities for future use in extension work in other villages.

4. Immediate objective 4

To promote the semi-assembly of animal-drawn carts and tillage implements for the SALT farming system.

4.1. Output 1

At least two village craftsmen in the PDVCH/SALT or neighbouring village fabricated at least four ox-drawn cart bodies and assembled them together with the wheel and axle kits semi-fabricated by at least two metalworks enterprises.

Activities for output 1

4.1.1. Adapt the design of a suitable single-ox-drawn cart from other countries, possibly that using parts of discarded motor vehicle rear axle and wheel assembly and wooden body to take advantage of locally available materials.

4.1.2. Provide ad-hoc technical advice to metalworkshop cooperators in semi-fabricating wheel and axle kits for ox-carts out of scrap motor vehicles and to village craftsmen for building ox-cart bodies. Involve the participation of WSP in this regard.

4.1.3. Demonstrate the use of the assembled ox-cart in coconut harvesting and other transport activities, both on and off the road in villages.

4.1.4. Monitor, evaluate and document by videotapes and photographs activities for future use in extension work in other villages.

4.2. Output 2

At least two metalworkshop cooperators fabricated ox-drawn steel mouldboard ploughs, peg-tooth harrows and inter-row cultivators.

Activities for Output 2

4.2.1. Promote the fabrication of animal-drawn implements to metalworkshop cooperators, through DAFF and AMITSST.

4.2.2. Provide ad-hoc technical advice in the fabrication of animal-drawn implements, the commercial units have been successfully tested and promoted among the farmers in PDVCH/SALT.

4.2.3. Monitor, evaluate and document by videotapes and photographs all significant activities for future use in extension work in other villages.

Inputs

Government inputs

1. Counterparts

(a) The Government, and in particular, DAFF, will commit some of its human resources (two senior extension officers) who are involved in WSFSP as counterparts to the project to effect efficient coordination in the implementation of the PDVCH/SALT. They will be given fellowships for a group study tour in Indonesia, the Philippines and Thailand, after which they will provide the leadership in the AMITSST, to be formed. Another DAFF staff with background and training in cattle husbandry, will serve as counterpart to the project particularly for implementing the PDVCH.

(b) DAFF will arrange, through a memorandum of agreement, with WSP regarding the commitment of WSP's instructors in machining and fabrication to provide technical assistance and on-the-job training services to metalworkshop workers and entrepreneurs trying to fabricate machinery introduced by the project through DAFF. To upgrade their capabilities and make them appreciate the development objectives of the project, DAFF will initially ask WSP to nominate two instructors in machining and fabrication for fellowships of which one will be for a 3-month training in semi-assembly of motorized tricycles and the other will be for joining a study tour in Indonesia, the Philippines and Thailand. DAFF is also expected to arrange with WSP to commit the two trained instructors to serve as members of the AMITSST which will be headed by a senior DAFF staff. In effect, the two WSP staff will also act as part-time counterparts in the project.

(c) Similarly, DAFF will arrange with USP for one agricultural engineer, preferably a Samoan national, as counterpart to the project. This USP staff will be given a fellowship for a group study tour to Indonesia, the Philippines and Thailand and will also be committed by USP to be a member of the AMITSST after the study tour.

(d) Similarly, DAFF will arrange with the Manufacturers Association for one metalworking entrepreneur to commit himself as counterpart in the project. This entrepreneur will be given a fellowship for a group study tour in Indonesia, the Philippines and Thailand and will also be committed by the Manufacturers Association to be a member of the AMITSST after the study tour.

2. Secretarial support

The project will have access to the DAFF's typist for all typing and secretarial work.

3. Office space and facilities

Office space and facilities will be provided for the technical advisers (AMITSST) and experts.

4. Transport

Transport costs and per diems will be provided for the project personnel in official travels to the villages.

5. Seminars, training and national meetings

(a) DAFF will provide funds for the debriefing seminars and logistics for demonstrations, arrangements and other activities peripheral but otherwise essential to the project.

(b) DAFF will provide the logistics for local training of metalworking entrepreneurs in semi-assembly of tricycles (motorcycle side-cars) and ox-cart wheel and axle kits as well as in fabrication of ox-drawn implements. Similarly, DAFF will provide funds for training village craftsmen in fabricating ox-cart bodies.

UNIDO and FAO inputs

1. Personnel

Expert in Agricultural Machinery and Chief Technical Adviser, 9 w/m (split missions; UNIDO)	US$117,000
Associate expert in fabrication (UNIDO), 12 w/m	Nil
Expert in livestock production, 6 w/m (split missions, FAO)	78,000
Expert in SALT farming systems, 6 w/m (split missions, FAO)	78,000
Associate expert in rural sociology or anthropology, 12 w/m (FAO)	Nil

2. Group training

Two fellowships for a 3-month practical training programme for one fabrication and welding instructor from WSP and for one technician from a private metalworkshop recommended by the Manufacturers Association, in fabrication of motorized tricycle animal-drawn implements and cart as well as horse saddlebaskets	20,000
Four fellowships for 34-day group study tour with practical training for one senior staff of DAFF, one agricultural engineer from USP, one fabrication workshop instructor from WSP and one metalworkshop entrepreneur recommended by the Manufacturers Association, in Indonesia (6 days), Philippines (15 days) and Thailand (6 days), including international air travel (7 days) (FAO)	40,000

3. Equipment

(a) Commercial machines for replication

Five motorized tricycles (motorcycles with side-cars) (UNIDO)	15,000
Five units each of single-ox drawn steel ploughs, peg-tooth harrows and inter-row cultivators complete with harness and accessories (UNIDO)	500
Five pairs of horse saddlebaskets (UNIDO)	200

Five units of single-ox carts with steel wheels and axles, rubber tires and wooden bodies (UNIDO)	2,300
Two units of coconut harvesting knife complete with extendible poles (UNIDO)	200
Two units of portable coconut huskers (UNIDO)	300
(b) Vehicles for transportation	
Two units pick-up trucks with double cab, 4-wheel drive (UNIDO $ 15,000, FAO $ 15,000)	30,000
Five units motorcycles, at least 100 cc. engine (UNIDO)	10,000
(c) Audio-visual and other equipment for machinery extension (UNIDO $ 10,000, FAO $ 10,000)	20,000
(d) Expendable equipment (UNIDO US$25,000; FAO US$27,500)	52,500
4. Joint UNIDO/FAO mission costs	20,000
5. Miscellaneous	11,000
Project total	**US$495,000**
of which UNIDO, US$231,000	
FAO,US$264,000	

REFERENCES

1. Asian Development Bank. Western Samoa agriculture sector study. Vol.1. Recommended strategies and programmes, April 1985.

2. Atkinson, W. D. Research and development possibilities for agricultural tools and implements in the South Pacific Islands Pacific Island Farm Tools. RAPA Publication: 1993/10.

3. Australian International Development Assistance Bureau. Western Samoa Farming Systems Project. Project Background, February 1993.

4. Bonin, Mark J. Observations and assessment of some design features of agricultural tools and implements to ensure safe and appropriate use, especially for spraying, seeding and tillage in Western Samoa. Pacific Island Farm Tools. FAO RAPA Publication: 1993/10.

5. De Silva, M. A. T. Draft report on transfer and utilization of technology: a country study of Samoa. UNCTAD Project RAS/86/168, Transfer and utilization of technology in least developed and island developing countries, 1990.

6. FAO RAPA. Report of FAO Regional expert consultation on agricultural implements and tools of the South Pacific Islands, 21-24 September 1992, Apia, Western Samoa. RAPA Publication: 1992/20.

7. Western Samoa Census, 1989.

TERMS OF REFERENCE

JOB DESCRIPTION
US/RAS/92/072/11-01

Post title: Expert in Agro-related Metalworking Industries

Duration: 10 m/m

Date required: 1 March 1993

Duty station: Bangkok/Thailand, with travel to selected LDC's of Asia and the Pacific Region

Purpose of project:

The purpose of the project is to provide assistance to the Least Developed Countries in the Asia and Pacific Region in terms of technical support to agro-related metalworking industries through fuller utilization of existing networks, technology exchange and promotion of TCDC. Preparation of detailed technical cooperation programmes in the areas of raw material procurement and cottage industries is also envisaged.

Duties:

The duties of the expert will be as follows:

- o collect data on ECDC/TCDC potential through visits to member countries.
- o provide ad hoc technical advice to enterprises and R&D institutions during field visits.
- o identify concrete prototypes needed in the participating countries.
- o establish the final list of prototypes to be exchanged.
- o undertake a preliminary review of needs, in the countries expressing interest, in the following areas:

1. Raw materials procurement;
2. Support services for cottage industries;
3. Concrete programme for the development oidentify constraints in the agro-related industries, and suggest possible remedies, including technical assistance projects.

o suggest projects to be formulated by UNIDO, and prepare some project concepts for further development by UNIDO.

Qualifications:

A mechanical engineer with extensive experience in metalworking, specifically related to the production of agricultural equipment, as well as producttechniques.

Language: English

Background information: Refer to the project document.

STATISTICAL DATA

Table 1. Types of machinery owned, hired or borrowed in Western Samoa.

Type of Machinery	Number of Holdings Owning	Number of Units Owned	Number of Holdings Hiring/Borrowing
Tractor	52	76	212
Rototiller	44	48	69
Copra drier	2231	2265	686
Banana Injector	671	699	137
Knapsack sprayer	4482	4968	970
Mist blower	354	412	135
Weed eater	384	417	132
Chain saw	1131	1267	609
Water pump	107	112	85
Electric generator	371	391	117
Pick up truck	1405	1617	918
Paopao boat	3159	3561	435
Other boat	114	127	22

Table 2. Number of livestock by region and by type in Western Samoa, 1989.

Region	Cows	Bulls	Other Cattle	Any Type of Cattle	Horses
Apia Urban Area	316	160	167	643	79
North-West Upolu	600	272	315	1,187	745
Rest of Upolu	3,083	1,559	1,114	5,756	1,006
Savaii	3,072	1,680	1,093	5,845	1,284
Total	7,071	3,671	2,689	13,431	3,114

Source: Western Samoa Census, 1989.

Table 3. Area under tree crops, hectares.

Island	Coconut	Coconut and Cocoa	Cocoa	Coconut, Cocoa and Banana	Coconut and Banana	Cocoa and Banana	Total
Savaii	15,616	8,332	2,546	4,556	156	628	31,834
Upolu	21,190	11,324	3,496	3,598	3,617	3,617	43,377
Total	36,806	19,656	6,042	8,154	3,773	2,780	77,211

Source: Western Samoa Census, 1989.

Table 4. Statistics on agriculture in Western Samoa.

Total population, 1986	157,400
Total number of households	15,474
Total number of parcels	33,796
Number of agriculturally active households, 70%	10,884
Number of non-agricultural households, 28%	4,273
Number of minor agricultural households	317
Number of operators	11,165
Total area of holdings, hectares	67,403
Average holding size, hectares	6
Average number of parcels per holding	3
Percentage of holdings under crops, %	77
Percentage of holdings land under bush/fallow, %	5
Percentage of holdings land under non-agricultural use, %	17
Total number of households keeping livestock	14,120
Total number of households not keeping livestock	1,354
Number of households using coconuts for human consumption	15,147
Total number of households using coconuts for animal consumption	13,275
Average weekly coconut consumption (human) per household, nuts	45
Average weekly coconut consumption (animal) per household, nuts	112

Source: Western Samoa Census, 1989.