Government of Lao People’s Democratic Republic

Executing Entity/Implementing Partner:
Ministry of Agriculture and Forestry, MAF, Vientiane, Lao PDR

Implementing Entity/Responsible Partner:
National Agriculture and Forestry Research Institute, NAFRI

United Nations Development Programme

Selected agriculture concepts, approaches, commodities for development of
CLIMATE CHANGE TRAINING AND ADAPTATION
MODULES FOR LAO PDR:
# 5: SMALL LIVESTOCK PRODUCTION

Improving the Resilience of the Agriculture Sector in Lao PDR to Climate Change Impacts
(IRAS Lao Project)

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SUMMARY

The MAF in collaboration with the UNDP and other Government of Lao (GoL) and Non-government Organisation (NGO) partners, has prepared five (5) modules or guides for extension officers/workers who will be involved in promoting good practices and technologies for climate change adaptation in the agriculture sector. Entitled the “Climate Change Training and Adaptation Module” or CCTAMs, these guides are part of the target outputs of the MAF – NAFRI project entitled “Improving Resilience in Agriculture Sector to Climate Change” or IRAS Project. The CCTAMs being developed are:

1. Overview of Climate Change Adaptation (CCA) for Upland farming conditions
2. Overview of CCA for Lowland Farming Conditions
3. CCA through On-farm and Community Level Water Management;
4. CCA in Crop Production;
5. CCA in Small Livestock

Process of preparation. Stakeholder consultations at the provincial and national levels identified the key issues as a result of the combined effects of natural resources degradation, inappropriate agricultural land use practices and climate change. Subsequent consultations identified possible measures that can be applied.

Objectives of the modules. The CCTAMs discusses the challenges posed by the combined effects of land degradation due to inappropriate land use practices and the effects of climate change. They then provide an overview of the range of practices and technologies that may be considered to adapt to climate change, at the same time addressing the issues of natural resource degradation.

The Climate Change Adaptation in Small Livestock Production. The CCA in Small Livestock Production focuses on Pig, Chicken and Goat. For each of these animals, the following inter related sets of recommended practices and technologies are recommended:

a) Protection against heat, rains, cold, floods and predators.

b) Proper nutrition to improve resistance against diseases and ensure the promised farmer income from livestock is achieved;

c) Protection against diseases through vaccination, health management and bio-security;

d) Breeding management especially on native breeds to improve capacity to withstand extreme environmental conditions and better resistance to diseases;
e) Raising forage at the farm level to address the increasing difficulty on obtaining green feeds especially during the dry months.

Among other concerns, the CTTAM highlights the immediately doable interventions that can directly reduce livestock losses and ensure its role as safety net for the farmer. These include proper attention and care of young animals in terms of shelter, nutrition and disease prevention. It discusses what can be done with the local breeds, which can better withstand harsh climatic conditions and can gain weight given an adequate nutritional management. The CCTAM highlights on simple breeding management practices (e.g. selection, timing of breeding etc.) of native breeds in order to obtain optimum benefits to the farmer.

This CCTAM contains two formats of information. The first is the set of existing locally generated extension materials produced by NAFES, NAFRI, and other GoL agencies as well as NGOs that can contribute to climate change adaptation. These discuss entire production cycles. The second format would be the direct description of climate adaptation technologies that are not yet discussed adequately in existing extension materials. However, the second type would focus on specific adaptation practices that may be applied to address the effects of climate change.

Benefits and Costs. If the good practices for nutrition and housing are applied, farm family can expect to benefit in terms reduced time to look for natural feeds and reduced time for getting the animals to marketable size. Time management would particularly benefit the women. Housing and nutrition allows the animal waste on-farm to be retained in the farm.

The practices will also reduce the likelihood of mortality particularly among the young animals as a result of protection from extreme weather, better nutrition and better protection from parasites and disease, the latter through housing, vaccination and bio security. The full growth potential of native breeds can be achieved through proper breeding management (e.g. avoiding inbreeding, promoting timing) and nutrition.

The key costs involve additional labor for construction and maintenance of well ventilated pens, establishment of on-farm forage plots and conducting the cut and carry system. Faithful observance of de-worming vaccination program will also mean additional costs to the farmer. The alternative of not adopting the practices appear very high : high mortality, long fattening periods, low live weights at sale, and in some cases, the loss of livestock while on free range.

Applicability in IRAS Project Sites. The technologies are generally applicable in all project sites of IRAS. However the exact combinations of technologies to be applied as well as timing will depend on the actual biophysical and socioeconomic situation in each village. Thus village conditions need to be studied first and priorities established by farmers (methods discussed under CCTAM #1).
Certain technologies are easy and can be applied immediately such as preventive farm sanitation, providing sufficient water and provision of simple housing for the evening (partial confinement). If vaccines are limited, one can start initially with the younger animals. Others require more time but preparatory actions need to be done in the first year. Full vaccination services will require early negotiation with local providers. To establish forage lots, it is good to test the different species first on small plots.
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<th>Full Form</th>
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<tbody>
<tr>
<td>AWD</td>
<td>Alternative Wetting and Drying</td>
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<td>ATIK</td>
<td>Agroforestry Technology Information Kit</td>
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<td>CCA</td>
<td>Climate Change Adaptation</td>
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<td>CCTAM</td>
<td>Climate Change Training and Adaptation Module</td>
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<tr>
<td>DAFO</td>
<td>District Agriculture and Forestry Office</td>
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<tr>
<td>DFID</td>
<td>Department for International Development</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<tr>
<td>FFTC</td>
<td>Food and Fertilizer Technology Center</td>
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<tr>
<td>GoL</td>
<td>Government of Lao</td>
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<tr>
<td>ICRAF</td>
<td>World Agroforestry Centre</td>
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<tr>
<td>ICRISAT</td>
<td>International Crops Research Institute for the Semi-Arid Tropics</td>
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<tr>
<td>IFAD</td>
<td>International Fund for Agriculture Development</td>
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<td>IRAS</td>
<td>Improving the Resilience of the Agriculture Sector in Lao PDR to Climate Change Impacts</td>
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<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
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<td>IWMI</td>
<td>International Water Management Institute</td>
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<td>MAF</td>
<td>Ministry of Agriculture</td>
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<td>NAPA</td>
<td>National Adaptation Programme of Action</td>
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<td>NAFRI</td>
<td>National Agriculture and Forestry Research Institute</td>
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<td>NGO</td>
<td>Non-government Organisation</td>
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<td>NVS</td>
<td>Natural vegetative strips</td>
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<td>PAFO</td>
<td>Provincial Agriculture and Forestry Office</td>
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<td>PhilRice</td>
<td>Philippine Rice Research Institute</td>
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<td>UNDP</td>
<td>United Nations Development Programme</td>
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<td>UNFCCC</td>
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THE CLIMATE CHANGE TRAINING AND ADAPTATION MODULE FOR SMALL LIVESTOCK PRODUCTION

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BACKGROUND AND INTRODUCTION

The need for Climate Change Adaptation

The Ministry of Agriculture (MAF) in collaboration with the UNDP is presently implementing the Project titled “Improving the Resilience of the Agriculture Sector in Lao PDR to Climate Change Impacts” or the IRAS Project. The project addresses the need to adapt to climate change in the agriculture sector.

The IRAS project document states that the current and future climate-related risks to Lao PDR and key areas of vulnerability have been analyzed in the country’s First National Communication (STEA, October 2000) to the United Nations Framework Convention on Climate Change (UNFCCC) and the National Adaptation Programme of Action (WREA, April 2009).

According to the updated Koeppen-Geiger classification from 2006, as cited by the IRAS project document, there will be more rainfall events in the centre and the northern part of the country during the first half of the century and an expansion of the current climatic conditions prevailing in the south. In the second half of the century these will slightly shrink again. These expected changes will require resilience and early gained adaptive capacity of the agricultural sector and farmers to cope with the situation. Seen as a function of exposure, sensitivity and adaptive capacity, Lao PDR ranks as one of the most vulnerable countries in the South East Asia.

Climate change is expected to change the frequency, intensity and location of existing climate hazards and challenge the existing coping mechanisms of the population; especially those living in rural and remote places (IRAS Project Document, 2010).

The IRAS Project

The main thrusts of the IRAS Project are to minimize food insecurity resulting from climate change in Lao PDR and to reduce the vulnerability of farmers to extreme flooding and drought events. Among the expected outcomes are as follows:

- Outcome 1: Knowledge base on Climate Change impacts in Lao PDR on agricultural production, food security and vulnerability, and local coping mechanisms strengthened;
- Outcome 2: Capacities of sectoral planners and agricultural producers strengthened to understand and address climate change – related risks and opportunities for local food production and socio-economic conditions
- Outcome 3: Community-based adaptive agricultural practices and off-farm opportunities demonstrated and promoted within suitable agro-ecological systems
- Outcome 4: Adaptation Monitoring and Learning as a long-term process
The Climate Change Training and Adaptation Modules or CCTAMs

Under the IRAS project, the MAF in collaboration with the UNDP and other Government of Lao (GoL) and Non-government Organisation (NGO) partners, is now preparing six (6) guidelines for extension officers/workers, who will be involved in promoting good practices and technologies for climate change adaptation in the agriculture sector. Entitled the “Climate Change Training and Adaptation Module” or CCTAMs, these guidelines are part of the target outputs of the MAF – NAFRI project titled “Improving Resilience in Agriculture Sector to Climate Change” or IRAS Project. The CCTAMs being developed are:

- Overview of Climate Change Adaptation (CCA) in Upland Farming;
- Overview of CCA in Lowland Farming;
- CCA through On-farm and Community Level Water Management;
- CCA in Crop Production;
- CCA in Small Livestock; and
- CCA in Fisheries

Objectives of the CCTAMs

a. Provide an overview of the challenges posed by the combined effects of climate change and land degradation due to inappropriate land use practices;

b. Provide an overview of the possible practices and technologies to adapt to climate change, at the same time address the issues of natural resource degradation; and

c. Serve as a quick reference to existing relevant extension materials and making the latter available to the extension officers/workers.

How were the CCTAMs prepared?

During the stakeholder consultations, both provincial and national levels, key issues due to natural resources degradation, inappropriate agricultural land use practices and climate change were identified. In the subsequent consultations, possible measures that can be applied were determined. The CCTAM assembles the key knowledge derived from communities and researchers in the field of natural resource management, sustainable agriculture and recent dialogue on climate change adaptation.

How will the CCTAMs be used?

The first step to be accomplished is to determine the location-specific needs of farming communities. PAFO and DAFO personnel may use CCTAM #1 on upland farming systems and the CCTAM #2 on lowland farming systems to obtain an overview of the upland and lowland situations as well as problems associated with drought and flood conditions.

The PAFO and DAFO, together with local authorities and local partners, can use Part 3 of the CCTAMs #1 and #2 to facilitate a simple community-based action planning processes for
climate change adaptation. This part also provides several participatory planning tools. Among the outputs would be priority issues and actions to be taken.

Based on the priorities set by farming communities, the extension officers in consultation with the local authorities will identify priority actions based on the options cited in the subsequent CCTAMs (crops, livestock and water management). Based on the agreement with the communities, the selected options will then be tested and demonstrated on the ground. Results from several seasons of observation will be documented and used to revise the CCTAMs and/or develop more detailed local guidelines.
SELECTED AGRICULTURE CONCEPTS, APPROACHES, COMMODITIES FOR THE DEVELOPMENT OF CLIMATE CHANGE TRAINING AND ADAPTATION MODULES FOR LAO PDR # 5: SMALL LIVESTOCK PRODUCTION

The direct effects of climate change on livestock include the increase of existing vector-borne diseases and the emergence and spread of new diseases. A serious constraint to livestock production is the high animal mortality caused by widespread incidence of animal diseases. More than 80 percent of chickens are said to die every year in upland villages and sporadic disease epidemics kill most pigs. Warming also alters heat exchange between animals and environment, feed intake, mortality, growth, reproduction, maintenance, and production of livestock.

Heat stress tends to lower feed intake, and consequently growth, overall well-being and reproductive capacity. Higher temperatures may increase the rate of development of pathogens or parasites that spend some of their life cycle outside their animal host, which may lead to larger populations. The occurrence of floods causes a significant loss of livestock production and livelihood, as well as problems in the spread of diseases and in sanitation.

The occurrence of either floods or droughts severely affects the agricultural sector (crop, livestock and fisheries. Locally, this was demonstrated in the 2007 flooding caused by Lekima Storm, which affected six provinces in the North, Central and Southern regions causing loss of livestock (aquatic and inland animals) worth 103.5 billion kip (10.5m USD). In a WFP report, although rice losses and paddy field damage is common and has immediate impact on the households, most villagers reported that losing livestock was the hardest for livelihood and family security.

After a flood, sanitation is a major concern in the village. Gastrointestinal diseases may persist for weeks after a flood. In addition to human health impacts, diseases may also affect many of the animals. Those pathogens and parasites that are sensitive to moist or dry conditions may be affected by changes in precipitation, soil moisture and the frequency of floods. During the long dry season and droughts, there is a lack of available feeds in the rural areas; poor nutrition causes low reproductive rates and weight gain.

To address the above concerns, the CCTAM for small livestock production aims to discuss measures that will:

- Guard against immediate livestock loss from disasters like flood, droughts and extreme heat;
- Strengthen the stamina against the increasing frequency of diseases;
- Maintain or improve feed efficiency, growth rate and reproductive capacity; and
- Enhance the integration of small livestock management into climate smart farming systems.
The criteria used in determining the measures to be included in the CCTAM are based on:

- Locally generated experience by farmer leaders and extension personnel;
- Promising research results by local and international agencies working in Lao;
- Information from other countries in the humid tropics with similar conditions;
- Technologies which are not overly dependent on external inputs and high labour inputs.

The recommended practices and technologies for CCA in small livestock production are as follows:

- Protection against heat, rains, cold, floods and predators.
- Proper nutrition to improve resistance against diseases and ensure the promised farmer income from livestock is achieved;
- Protection against diseases through vaccination, health management and bio-security;
- Breeding management especially on native breeds to improve capacity to withstand extreme environmental conditions and better resistance to diseases;
- Raising forage at the farm level to address the increasing difficulty on obtaining green feeds especially during the dry months.

This CCTAM contains two formats of information. First is the set of existing locally generated extension materials produced by NAFES, NAFRI, DLFD and other GoL Agencies as well as NGOs that can contribute to climate change adaptation. The existing extension materials listed in this CCTAM, basically describes the entire production processes and corresponding agricultural technology for small livestock production. These materials describe certain breeds of animals (native and exotic breeds) and cross-breeding opportunities. Copies will be provided to the PAFO and DAFO working in the IRAS project sites.

The second format would be the direct description of approaches and technologies that are not yet discussed adequately in existing extension materials. The descriptions would be the main content of the CTTAMs. However, they would focus on specific adaptation practices that may be applied to address the effects of climate change on small livestock.

Among other concerns, the CTTAM highlights the immediately doable interventions that can directly reduce livestock losses and improve income. These include proper attention and care of young animals in terms of shelter, nutrition and disease prevention. It discusses what can be done with the local breeds, which can better withstand harsh climatic conditions and can gain weight given an adequate nutritional management.

Highlighted below are selected practices for pigs, goats and chicken. Under each type of animal, there will be a discussion on the following topics: a) protection against extreme weather; b) nutrition; c) disease prevention and management; and d) breeding management. A common chapter – the raising of forages on farm - is then provided.
CLIMATE CHANGE ADAPTATION IN PIG RAISING
1.0 PIG RAISING

There are three (3) interrelated key actions – protection from extreme weather, nutrition, and disease control - that should be considered. The currently high mortality rate is due to diseases, which is directly influenced by the type of housing, nutrition, and disease prevention measures.

1.1 PROTECTING PIGS AGAINST EXTREME WEATHER CONDITIONS

1.1.1 RATIONALE FOR THE ACTION

Exposure to too much heat tends to decrease appetite and reduce feed intake. Extremely hot weather or very long wet periods also predisposes the animals, especially the young, to stress and increases their vulnerability to diseases.

Housing the pigs has many advantages in the farming system. It protects pigs, particularly the young from harsh heat and rains, which predisposes them to ailments. It allows the farmer to collect manure, which can be used for crop production especially vegetable and fruit gardens, Scavenging does not lead to fast growth; rather it predisposes the pigs to diseases and parasites and destroys crops and gardens. It also promotes inbreeding. If the farmer can commit to provide sufficient and balanced feed to his/her penned pigs daily, and establish an on-farm source of feeds, then housing would be recommended.

1.1.2 RECOMMENDED PRACTICES

a) Siting and construction

- Locate the pig pen near a water source and where forage crops can also be grown, this will facilitate pig husbandry operations;
- Build on high ground that is lesser prone to floods and far enough from houses to keep the smell at a distance;
- Build in a well-ventilated area with the long side of the pen in an east-west direction. A few trees nearby would help;
- The housing can be made of local materials such as bamboo and roof made of cooler material;
- Use raised slatted floors with a slight gradient to allow feces, urine and water to drop through the floor in one section of the pen; and
- Provide separate areas for feeding, sleeping and dunging to promote hygiene.

b) Stock Density
• Avoid overcrowding of animals. Observe the proper spacing requirements. Young pigs less than 20 kg require up to 0.6 m; grower pigs up to 0.8 m; while finishers require up to 1.2 m;
• Segregate the age groups – piglet, gilt, breeder, lactating sows.
• Adequate water to combat heat stress and aid in nutrition
• Be alert to the signs of dehydration such as heavy panting and provide more water;
• Provide a stable water receptacle. It must be stable to prevent spillage and soiling. The use of simple drinking nipples is recommended to minimize contamination;
• Sprinkle water on the pig when it is too hot;
• If the farmer prefers his pigs to be on a free range, provide for a wallowing pit, the mud will help reduce perspiration; and

CIAT Information Sheet #5 provides guidance in designing a well-ventilated and hygienic pig pens. While Information Sheet #4 provides guidance in providing water to pigs though the use of simple drinking nipples.

1.2 PROPER NUTRITION FOR PIGS

1.2.1 RATIONALE FOR THE ACTION

Proper nutrition is an important hedge against diseases and is directly related to the growth and daily gains in live weight. The higher the feed intake of good quality ration, the faster it will grow. The common pig feeds are rice bran, broken rice and cassava roots. These provide energy but are deficient in protein and vitamins.

To augment the energy providing feeds, farmers especially women, spend several hours a day to collect various plants to serve as green feeds (banana stems, wild taro leaves, weeds, etc.). These fibrous green feeds have been proven to provide protein, minerals and vitamins to small animals. However, a high fiber diet slows down the pace of passage of feed through the digestive track and reduces the amount of feeds that can be consumed.

A variety of *Styllosanthes guianensis*, a legume and so-called Stylo 184, contains high protein and proven to double the live weight gain of animals and cuts by half the time needed for fattening the pig. However, this is also rich in fiber content.

1.2.2 RECOMMENDED PRACTICES

The following specific actions are recommended in order to provide proper nutrition (high energy, high protein):

a) Unlimited feeding especially to growing pigs and lactating sows;
b) Increase consumption of protein. Commercial feeds such as fish meal and soybean meal are ideal sources. In areas where these are not available, proteins are obtained from leguminous green feeds such as Stylo 184. Due to the limited animal’s consumption of fibrous feeds (including Stylo), Stylo 184 can be fed in special forms especially for young pigs. These include the following:
- As plucked tips of young plants (2 to 3 weeks from the last cutting);
- As ground leaf meal.

c) Use other leguminous sources from the farm such as the “Pintoi” peanut, *Leucaena leucocephala*, cowpea, pigeon pea. Two grams of lime and salt may be provided per day.

The CIAT Information Sheet #1 provides more information in improving the protein composition of feeds. CIAT Information Sheet #2 provides information on how to grow and manage Stylo 184.

1.3 PREVENTING DISEASE IN PIGS

1.3.1 RATIONALE FOR THE ACTION

Prevention from disease infections lessens the mortality rate of animals and a better option than costly and often unsuccessful treatments of disease outbreaks. Preventive measures consist of direct measures such as practicing hygiene, de-worming and vaccination and indirect measures such as protection from extreme weather events and proper nutrition.

1.3.2 RECOMMENDED PRACTICES

a) De-worming

This allows pigs to grow more quickly and become healthier and less vulnerable to disease infections. De-worming is most useful for pigs that are penned. Dewormed pigs but are not penned can easily get reinvested. De-worm piglets before they are put in the pens. De-worm sows 2 weeks before farrowing to protect newly born piglets.

CIP Information Sheet #6 provides detailed information on the actions and timing of de-worming. CIP Village Learning/Activity #1 also describes the extension approach in convincing farmers to practice de-worming.

b) Vaccination

Check what diseases are prevalent in the area. Prioritize the vaccines to be given based on the history of disease in the area:
classical swine fever or hog cholera;
foot and mouth disease;
Porcine Respiratory and Reproductive Syndrome (PRRS)

Classical swine fever is the major disease affecting pigs in Laos and causes significant losses. This can only be prevented through vaccination, improved housing, bio-security and good hygiene especially for piglets. These will generally reduce the rate of other infectious diseases and associated deaths.

Vaccine storage and transport is always a limitation to the provincial and district offices because it requires certain degree of cooling to preserve and maintain the potency of vaccine. Prioritize the most vulnerable population such as sows and piglets if the vaccine is not readily accessible and limited in volume.

c) Other practical preventive measures including bio-security

- Make sure that the piglet sucks the colostrums or first milk of the mother to stock up antibodies;
- Administer iron and de-worming. Give iron to prevent anaemia. Clean the pig sty everyday with water;
- To save water, dry clean the floor first by sweeping and collecting the pig waste before applying water;
- Apply disinfectants such as bio-extracts;
- Before purchasing new stock, ensure that they have been de-wormed and vaccinated;
- Quarantine newly bought stock;
- Spot, isolate and dispose animals that are slow growers;
- Avoid feeding animals with uncooked kitchen scrap, if possible, always cook them; and
- Avoid overcrowding animals.

CIP Information Sheet #7 provides guidance in reducing the risk of disease outbreaks using pens, vaccination and village quarantine.

1.4 BREEDING MANAGEMENT FOR PIGS

1.4.1 RATIONALE FOR THE ACTION

Native breeds are generally perceived to have better adaptive capacities to local climatic conditions such as high temperatures and high humidity. Native breeds are known to subsist well on management systems that rely on scavenging for nutrition. The protein requirements for native breeds are not well known, but they are generally understood to be lesser than those of the exotic breeds. The CIAT estimates that protein requirement would likely range from at least 18% for young piglets to 10% for older growing pigs.
A study indicated that the native breed Moo lat could grow up to 500g/day based on high quality commercial pig diet (Egerszegi et al. 2008). This indicates that low growth rates among native breeds are probably due to feed restriction rather than genetic potential.

1.4.2 RECOMMENDED PRACTICES

a) Native Breeds

Table 1a is a summary of the key characteristics of native breeds from the study conducted by Keonouchanh et al. in 2008 for MAF and ATK. No official recommendations have been made on which breed would be the most suitable for conditions under climate change. Farming communities would have a better knowledge of the characteristics of these breeds, especially in relation to the ability to withstand heat stress, utilize a diverse range of native feeds and relative resistance to common diseases. It would be helpful to document farmer observations.

Based on the given reproductive characteristics, Type 3 breed of Lao native pig appears to have an edge over other breeds (Table 1b). However, the same information cannot adequately indicate which breeds are more adaptable to climatic changes. Documentation of farmer knowledge would be valuable in this regard.

b) Selection of good stock and breeding management

In order to tap the full genetic potential of native breeds, one must also manage the breeding process of the native breeds to produce healthy and productive offspring; the key criteria for selecting boars and gilts are indicated in Table 1c.

Manage the natural breeding process to produce healthy offspring. This involves ensuring that both parents are well fed; the boar is trained on breeding habits; bred at the right age; insulated from stress and bred at the proper period (e.g. on the 2nd or 3rd in heat of the gilt). Avoid inbreeding; thus, do not select boars for breeding within same family lines.

The MAFF and EU publication entitled *A Manual on Improved Rural Pig Production* provides detailed guidance on how to manage the breeding process for both native and exotic species.
Table 1a. Lao PDR native pig breeds and key characteristics.

<table>
<thead>
<tr>
<th>Location and Morphological characteristics</th>
<th>Reproductive characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type 1: Moo Chid, Moo Markadon, Moo Boua</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Found in:</strong> scattered in all nations of the country</td>
<td><strong>Age at first estrus:</strong> between 182-397 (8 months) with body weight of 21-31 kg</td>
</tr>
<tr>
<td><strong>Size:</strong> relatively small compared to three other types existing in the country</td>
<td><strong>Maturity weight of sows:</strong> 42-48 kg</td>
</tr>
<tr>
<td><strong>Color:</strong> coat is mainly black with white legs</td>
<td><strong>Age at first farrowing:</strong> 360 days</td>
</tr>
<tr>
<td><strong>Ears:</strong> small, short and direct ears</td>
<td><strong>Farrowing rate:</strong> 1.5 litters per year</td>
</tr>
<tr>
<td><strong>Body length:</strong> 75-92 cm</td>
<td><strong>Piglets per year:</strong> 7-8 piglets per litter</td>
</tr>
<tr>
<td><strong>Girth circumference:</strong> 72-85 cm</td>
<td><strong>Weaning date:</strong> 3 months</td>
</tr>
<tr>
<td><strong>Height:</strong> 46-54 cm</td>
<td><strong>Weaning weight:</strong> 7.8 kg</td>
</tr>
<tr>
<td></td>
<td><strong>Boar average body weight:</strong> 20.5 kg with 172-300 days old</td>
</tr>
<tr>
<td></td>
<td><strong>Boar maximum body weight:</strong> 18-30 kg</td>
</tr>
<tr>
<td><strong>Type 2: Moo Lat</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Found in:</strong> Louangprabang, Oudomxay, Xaysomboun) and also found in some lowland provinces such Saravane and Savannakhet provinces</td>
<td><strong>Age at first estrus:</strong> between 189-586 days (356 days) with 39 kg of body weight</td>
</tr>
<tr>
<td><strong>Size:</strong> This type is quite bigger than first one</td>
<td><strong>Maturity weight of sows:</strong> 47-61 kg</td>
</tr>
<tr>
<td><strong>Color:</strong> legs and in front of face are white color</td>
<td><strong>Age at first farrowing:</strong> 360 days</td>
</tr>
<tr>
<td><strong>Ears:</strong> short and direct ears</td>
<td><strong>Farrowing rate:</strong> 1.5-1.8 litters per year depends on management systems</td>
</tr>
<tr>
<td><strong>Face:</strong> straight face</td>
<td><strong>Piglets per year:</strong> 7-8 piglets per litter</td>
</tr>
<tr>
<td><strong>Body length:</strong> 85-100 cm</td>
<td><strong>Normal weaning date:</strong> 60-90 days 9.5 kg</td>
</tr>
<tr>
<td><strong>Body Circumference:</strong> 84-102 cm</td>
<td><strong>Average weaning weight:</strong> 9.5 kg</td>
</tr>
<tr>
<td><strong>Girth height:</strong> 51-70 cm</td>
<td><strong>The maturity of male</strong> has lower body weight than female due to lack of mating management</td>
</tr>
<tr>
<td></td>
<td><strong>Average body weight:</strong> 25 kg</td>
</tr>
<tr>
<td></td>
<td><strong>Maximum body weight:</strong> 30-50 kg</td>
</tr>
<tr>
<td><strong>Type 3: Moo Nonghad, Moo Hmong</strong></td>
<td></td>
</tr>
<tr>
<td>Location and Morphological characteristics</td>
<td>Reproductive characteristics</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Found in:</strong> Nonghad district, Xienkhouang province</td>
<td><strong>Age at first estrus:</strong> between 150-180 days (5-6 months) with body weight of 30-40 kg</td>
</tr>
<tr>
<td><strong>Size:</strong> quite big</td>
<td><strong>Maturity weight of sows:</strong> 65-85 kg</td>
</tr>
<tr>
<td><strong>Body length:</strong> 100-105 cm</td>
<td><strong>Farrowing rate:</strong> 1.5-1.8 litter per year</td>
</tr>
<tr>
<td><strong>Girth circumference:</strong> 115-130 cm</td>
<td><strong>Piglets per year:</strong> 7-10 piglets per litter</td>
</tr>
<tr>
<td><strong>Height:</strong> 55-76 cm</td>
<td><strong>Age at first farrowing:</strong> 10-11 months</td>
</tr>
<tr>
<td><strong>Color:</strong> black with pink in abdominal region</td>
<td><strong>Weaning date:</strong> 2-3 months</td>
</tr>
<tr>
<td><strong>Face:</strong> short and bend</td>
<td><strong>Average weaning weight:</strong> 8 kg</td>
</tr>
<tr>
<td><strong>Ears:</strong> medium and direct ears</td>
<td><strong>Boar maximum body weight:</strong> 60-80 kg</td>
</tr>
</tbody>
</table>

**Type 4: Moo Deng, Moo Berk**

<table>
<thead>
<tr>
<th>Found in: only in southern part of Lao particularly in Mounlapamok and Khongdistricts, Champasack province; well-adopted and cross-breed pig</th>
<th>Maturity weight of sows: around 65-90 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size:</strong> bigger than the other existing types</td>
<td>Age at first farrowing: 11-12 months</td>
</tr>
<tr>
<td><strong>Face:</strong> short and bend</td>
<td>Farrowing rate: 1.5-1.8 litter per year</td>
</tr>
<tr>
<td><strong>Ears:</strong> large and dropping ears</td>
<td>Piglet per year: 7-10 piglets per litter</td>
</tr>
<tr>
<td><strong>Body length:</strong> 88-120 cm</td>
<td>Weaning rate: 2-3 months</td>
</tr>
<tr>
<td><strong>Girth circumference:</strong> 84-116 cm</td>
<td>Average weaning weight: 8.5 kg</td>
</tr>
<tr>
<td><strong>Height:</strong> 60-70 cm</td>
<td>Boar maximum body weight: similar to sows</td>
</tr>
</tbody>
</table>

Source: Keonouchanh et al. MAF and ATK (2008)
Table 1b. Comparative analysis of key characteristics

<table>
<thead>
<tr>
<th>Breed/Characteristic</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Type 4</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at 1st estrus (days)</td>
<td>182-397</td>
<td>189-586</td>
<td>150-180</td>
<td>no data</td>
<td>low</td>
</tr>
<tr>
<td>Weight at 1st estrus (kg)</td>
<td>21-31</td>
<td>39</td>
<td>30-40</td>
<td>no data</td>
<td>not too significant characteristic</td>
</tr>
<tr>
<td>Maturity weight of sows (kg)</td>
<td>42-48</td>
<td>47-61</td>
<td>65-85</td>
<td>65-90</td>
<td>relative to boar weight</td>
</tr>
<tr>
<td>Age at 1st Farrowing (days)</td>
<td>360</td>
<td>360</td>
<td>300-330</td>
<td>365</td>
<td>low</td>
</tr>
<tr>
<td>Farrowing Rate (litter/year)</td>
<td>1.5</td>
<td>1.5-1.8</td>
<td>1.5-1.8</td>
<td>1.5-1.8</td>
<td>high</td>
</tr>
<tr>
<td>Number of Piglets (litter/year)</td>
<td>7-8</td>
<td>7-8</td>
<td>7-10</td>
<td>7-10</td>
<td>high</td>
</tr>
<tr>
<td>Weaning period (days)</td>
<td>90</td>
<td>60-90</td>
<td>60-90</td>
<td>60-90</td>
<td>low</td>
</tr>
<tr>
<td>Weaning weight (kg)</td>
<td>7.8</td>
<td>9.5</td>
<td>8.0</td>
<td>8.5</td>
<td>high</td>
</tr>
<tr>
<td>Boar average body weight (kg)</td>
<td>20.5</td>
<td>25.0</td>
<td>no data</td>
<td>no data</td>
<td></td>
</tr>
<tr>
<td>Boar max body weight (kg)</td>
<td>18-30</td>
<td>30-50</td>
<td>60-80</td>
<td>no data</td>
<td>relative to sow weight (should be heavier than sow)</td>
</tr>
</tbody>
</table>

Source: Keonouchanh et al. MAF and ATK (2008)

Table 1c. Desired characteristics of animals for breeding

<table>
<thead>
<tr>
<th>Boars</th>
<th>Gilts</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Select offspring from a sow that has consistently farrowed and weaned large litters</td>
<td>• Select from a sow that has farrowed and weaned large litters (not less than 9 piglets)</td>
</tr>
<tr>
<td>• Select the boar from a sow that has a good size and not less than 12 nipples</td>
<td>• The gilt should have a good size and not less than 12 nipples (same criteria for mother)</td>
</tr>
<tr>
<td>• The boar should have grown fast and be in good health with strong legs</td>
<td>• The boar should have grown fast and be in good health with strong legs</td>
</tr>
<tr>
<td>• The boar should have a good reproductive organ</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Oosterwijk, G. et al. DLF/MAF (2003)

1.5 BENEFITS AND COSTS

The benefits would include reduced mortality especially among the young as the pigs will be more resistant to diseases. If the farmers can raise certain legumes for protein on farm, and feed them to the pigs, the time for searching green feeds daily especially by women will be reduced. The period to fatten the pigs will also be reduced by half, thereby making it a good emergency safety net against crop production failures. Native breeds will also be able to achieve genetic potential with improved breeding management and better nutrition.

Most of the costs are similar to the labor costs under conventional practices. The incremental costs would be including:
a) labor and materials (mostly local) for pig housing including special feeding trough and installation of water nipples;
b) labor for establishing and maintaining small plots of forage;
c) additional labor for converting legumes into leaf meal for young animals;
d) better village level coordination to ensure more effective vaccination including the appointment and training of village veterinary workers;
e) in the remote upland areas where vaccine is not readily available, additional time and effort for strict adherence to farm sanitation and other related preventive measures;
f) more time and attention to prevent inbreeding, select good parents and manage the breeding process.

1.6 APPLICABILITY IN IRAS PROJECT SITES

The applicability of the above practices in IRAS project sites would depend on the access to affordable inputs such as supplemental commercial feeds and vaccines. In the more remote upland areas of northern project sites, limited access to commercial feeds means more attention to the production on farm leguminous forage as sources of protein, vitamins and minerals.

In upland areas, day and night housing may not be immediately adopted. Farmers may wish to start with “Night Only” housing, supplemented by on-farm supply of forage. Special arrangements are also needed to make important vaccines (with low temperature requirements) available to the entire neighbourhood, if not in the village.

1.7 COMPANION MATERIALS (LOCAL EXTENSION MATERIALS) THAT COME TOGETHER WITH THIS CCTAM

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoL</td>
<td></td>
</tr>
<tr>
<td>• Raising Pigs</td>
<td>NAFES</td>
</tr>
<tr>
<td>• Native pigs (Moo Lat) production in Lao PDR</td>
<td>NAFRI and ATK</td>
</tr>
<tr>
<td>• A Manual On Improved Rural Pig Production</td>
<td>DLF / MAF</td>
</tr>
<tr>
<td>INGOS</td>
<td></td>
</tr>
<tr>
<td>• Pig Info #1 - How To Improve Feeding of Pigs</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Pig Info #2 - How To Grow and Manage Stylo</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Pig Info #3 - How To Build Good Feed Troughs</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Pig Info #4 - How To Provide Clean Water to Pigs</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Pig Info #5 - How To Build Good Pig Pens</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Pig Info #6 - De-Worming Of Pigs</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Pig Info #7 - Reducing The Risk Of Disease Outbreaks- Using Pens, Vaccination and Village Quarantine</td>
<td>CIAT</td>
</tr>
<tr>
<td>• VLA #1 - De-worming of Pigs</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Overview: Pig Fattening Technologies</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Tool # 1: Village Learning Activities (VLA)</td>
<td>CIAT</td>
</tr>
<tr>
<td>• How To Grow, Manage and Use Forages</td>
<td>CIAT</td>
</tr>
<tr>
<td>• Good Practice Note Pig Raising in Rural &amp; Remote Laos</td>
<td>CARE</td>
</tr>
</tbody>
</table>
Figure 1. Climate change adaptation in pig raising

Figure 1.1. Simple housing to protect pigs from heat and long wet conditions particularly among the young is a practical adaptation strategy. (Source: CIAT Pig Info Sheet #5. How to build good pig pens).

Figure 1.2. We must make sure the pigs drink sufficient water. A simple container, a house and water nipple is a good low cost investment. If needed, water may also be sprinkled on pigs to manage body heat (Source: MAFF – EU 2003. A manual on improved rural pig production).
Figure 1.3. We must provide comfort zones for the very young piglets, especially for the early weaners. Young piglets have almost no tolerance to environmental changes. A draft free and warm comfort zone must be available to piglets at all times. (Source: MAFF – EU 2003. A manual on improved rural pig production)

Figure 1.4. Part of good practice in pig is to build good feeding troughs that will encourage the pig to eat more, grow faster and at the same time they don’t contaminate their feed with animal waste. (Source: CIAT Pig Information Sheet #3 How to build a good feed trough).

Figure 1.5. Stylo 184 is a nitrogen-fixing legume plant that can be fed fresh to pigs. It's high protein can boost growth. Farmers report that it can halve the time to fatten pigs. If planted in the farm, it can reduce the time of women to look for feeds by at least two hours. (Source: Pig CIAT Information Sheet# 2 How to grow and manage stylo).
Figure 1.6. The immunity and nutritional requirement of young piglets are very delicate. In addition to de-worming and vaccination, ensure that they are able to suck the colostrum (first milk of the mothers) and they are given the balanced nutrition (energy and protein). Water consumption is also very important (Source: MAFF – EU 2003. A manual on improved rural pig production).

Figure 1.7. Cleaning the pen regularly is one way of preventing disease. Manure and urine may be composted and used for crop production (Source: MAFF – EU 2003. A manual on improved rural pig production).

Figure 1.8. Newly procured pigs should be quarantined before they join the herd (Source: MAFF – EU 2003. A manual on improved rural pig production).
Figure 1.9. De-worming allows the pig to fully benefit from its feed intake. De-wormers can be administered with hassle when hidden in a sticky rice ball. (Source: CIAT Pig Information #6: De-worming of Pigs).

Figure 1.10. Systematic vaccination (preferably village wide) combined with penning, nutrition and farm sanitation is the realistic solution to major diseases. Treating disease when it happens would be costly and not always successful.

Figure 1.11. The native breed Moladt is able to grow more than 500g/day when high quality feed. This could mean that feed restriction, rather than genetics may have more effect on low growth rate at the farm level (Source: Soukanh Keonouchanh (MAF) et al., 2008 Native pigs (Moo Lat) production in Lao PDR).
Figure 1.12. In addition to good nutrition, the farmer can take advantage of the adaptive traits of native breeds though proper breeding management. To make sure that sturdier offspring are produced, prevent inbreeding and select parents with desirable survival, growth and reproductive characteristics.
CLIMATE CHANGE ADAPTATION IN GOAT RAISING
2.0 GOAT RAISING

2.1 PROTECTING GOATS FROM EXTREME WEATHER CONDITIONS

2.1.1 RATIONALE FOR THE ACTION

Goats are vulnerable to parasites and diseases, which tend to increase due to increased incidence of harsh weather conditions such as high temperature and humidity. Goats are particularly vulnerable to wet and very cold conditions, which predispose them to pneumonia. Also, high temperatures greatly diminish the appetite of ruminants like goat. It is therefore, important to provide simple protection for the goats from such conditions.

2.1.2 RECOMMENDED PRACTICES

If the farmer can commit to provide sufficient feeds to the penned animals, it is best to confine the goats in elevated pens in order to minimize exposure to harsh heat and cold.

   a) It can be a wooden house, with bamboo floor, with roof and open sides.

       The floor should be 1.5 meters high from the ground to facilitate cleaning of the manure.

   b) Provide good ventilation to prevent the build up of methane from the stool, which predisposes animals to respiratory diseases. Majority of pneumonia cases can be traced to excessively warm and humid interior and sudden changes in temperature.

   c) At the sides of the house, provide food and drinking water.

   d) Separate pens should be provided for lactating and dry does, kids, growers and bucks. The buck pen should be visible to breeding does yet far enough to avoid transfer of the typical goat smell especially to lactating does, if milk is to be sold.

   e) Minimize stocking density to avoid stress. This is approximately 1 animal to 1 square meter.

2.2 PARASITE AND DISEASE PREVENTION FOR GOATS

2.2.1 RATIONALE FOR THE ACTION

If goats succumb to parasites and diseases, farmers lose a major safety net in the case of major disasters. While housing and proper nutrition indirectly help prevent diseases through better resistance, the recommendations here deal with direct measures to prevent disease occurrence. Prevention through bio-security is vital as efforts for treatment could be very expensive and not very successful.
2.2.2 RECOMMENDED PRACTICES

(a) Prevention of parasite infestation

- De-worming should start at 3 weeks, at weaning age (1.5 mo.), and every after 6 months.
- De-worm before confining.
- Practice rotational grazing to minimize parasitism.
- Avoid cutting forage to less than 15 cm above the ground to avoid catching parasite larvae.

(b) Disease prevention

- Observe a vaccination program with the help of trained and authorized extension workers.
- In procuring new stock, make sure they are disease free and subject them to quarantine before joining in the herd.
- Prevent feces from contaminating the feeds and water in the pens. Place the feeding trough and water containers above the floor of the pen.
- Keep feeds (concentrates, etc.) in rodent-proof containers and avoid spilling feeds on the floor which attract birds.
- Clean the pens and feeding troughs regularly.
- Limit visitors from other villages to the pen area.
- Immediately report unusual symptoms to the designated technicians.
- Immediately separate diseased animals from the rest of the herd.
- Bury diseased animals.
- For farmers who prefer to graze their goats daily, release the goats only after the moist dew has dried off the grass (to prevent disease).

2.3 IMPROVING NUTRITION IN GOATS

2.3.1 RATIONALE FOR THE ACTION

Climatic aberrations lead to higher incidence of diseases. Undernourished stock is less resistant to diseases. Confining goats will help prevent parasitic and disease infection. It prevents crop damage. But the challenge is to avoid underfeeding of goats in confined state since this would mean that the farmer has to spend time producing the green feeds. On the other hand, free-range goats are more susceptible to parasite and diseases. Green feeds during summer also tend to be insufficient. There is a need to help the farmers make the right actions to nourish the goat herd adequately, without overly requiring high labor costs or cost of feed inputs.
2.3.2 RECOMMENDED PRACTICES

(a) If the farmer would prefer to sustain the practice of scavenging, encourage the following initial modifications:

- Let the flock graze on old shifting cultivation fields, faraway from cultivated fields to prevent crop damage; fallow land of about 1-2 years is best for goats since edible forage are growing well before they are over shaded by regrowing shrubs; and provide supplementary feeding in the evening.
- Supplemental feeding can be made with the following forage grown in the farm:
  - Grasses: *Panicum maximum* (Simuang), *Peniseum purpureum* (Napier)
  - Legume: *Stylosanthes guianensis* (stylo 184)
  - Cereals: sun dried cassava tubers and leaves
  - Provide salt regularly to encourage the goats to return to the pens at night (10 grams of iodized salt per 100 kg live weight of goats every day).
  - Plenty of drinking water when kept in pens overnight.

(b) If the farmer prefers to confine his goats day and night, proper housing must be built. Establish a forage lot near the goat house as regular source of improved grasses and legumes.

More information on specific steps can be obtained from NAFES publication on goat raising and from CARE information sheet entitled *Good Practice Note Goat Raising in Rural & Remote Laos*.

2.4 BREEDING MANAGEMENT FOR GOATS

2.4.1 RATIONALE FOR THE ACTION

Most farmers in the country rely on native breeds, which are adapted to the local climatic conditions. Improvements in nutrition and health among native breeds would be the key to productivity and income. For most small scale backyard operations, breeding management rather than acquiring better breeds would be more immediately doable. This involves farm production of healthy stock that can have longer lives and thus, be able to yield more meat and milk with simple improvements in nutrition and health.

2.4.2 RECOMMENDED PRACTICES

a) Prevent inbreeding by practicing castration among male kids a few weeks after birth.

b) Make an effort to separate the buck from the doe to prevent indiscriminate breeding.

c) Even if separated, make sure that the buck is visible to the breeding does.

d) Select those buck and does that are good parents.
e) Breed at the right maturity and right time. Schedule the breeding so that no kids are born during wet months when death rates are highest. It is preferred that kids are born at the end of the wet season. One way to do this is to sell all breeding bucks during the early part of the year.

f) If the farmer desires to cross breed native does with exotic breeds, use large native does with a minimum weight of 25 kilos or more and those that have given birth at least once, to prevent unsuccessful deliveries.

Table 2a. Desired characteristics of does and bucks for breeding.

<table>
<thead>
<tr>
<th>Bucks</th>
<th>Does</th>
</tr>
</thead>
<tbody>
<tr>
<td>• One year old breeder or buck that have successfully mated once is desirable.</td>
<td>• Does should be purchased from a locality or area with similar climatic conditions.</td>
</tr>
<tr>
<td>• Buck must come from doe with high twinning rate.</td>
<td>• Udder should be palpated for size, detection of lumps and other abnormalities.</td>
</tr>
<tr>
<td>• Buck must be active and ready to breed in-heat doe.</td>
<td>• Teats should be uniform at length and large enough for easy milking.</td>
</tr>
<tr>
<td>• Good anatomical structure (firm feet and legs) and well formed reproductive organs.</td>
<td>• Good anatomical structure (firm feet and legs) and well-formed reproductive organs.</td>
</tr>
<tr>
<td>• Replace buck, preferably, every three (3) years.</td>
<td>• It must have a good appetite, possessing alert eyes and well formed pupils.</td>
</tr>
</tbody>
</table>

Source: Bureau of Agricultural Research Philippines, 2010

More information on specific steps can be obtained from NAFES publication on goat raising and from the CARE information sheet entitled *Good Practice Note Goat Raising in Rural and remote Laos.*

**2.5 BENEFITS AND COSTS**

The benefits would include reduced mortality especially among the young. There is lesser likelihood of parasite infection and improved resistance to diseases due to protective housing. If farmers can raise certain legumes for protein on farm and feed them to the goats, the goats will be better nourished and produce more meat and milk. Native breeds will also be able to achieve their genetic potential with improved breeding management and better nutrition.

Most of the costs are similar to the labor costs under conventional practices. The incremental costs would include:

a) labor and materials (mostly local) for housing;

b) better village level coordination to ensure more effective vaccination including the appointment and training of village veterinary workers;
c) in the remote upland areas where vaccine is not readily available, additional time and effort for strict adherence to farm sanitation and other related preventive measures;

d) more time attention to prevent inbreeding, select good parents, and manage the breeding process.

2.6 APPLICABILITY IN IRAS PROJECT SITES

The recommended practices are generally applicable in IRAS project sites depending on the remoteness from urban areas and sources of important inputs such as supplemental commercial feeds and vaccines. In the more remote upland areas of northern project sites, limited access to commercial feeds means more attention to the production of on-farm leguminous forage. Special arrangements are also needed to make important vaccines (with low temperature requirements) available to the entire neighbourhood, if not in the village.

2.7 COMPANION MATERIALS (LOCAL EXTENSION MATERIALS) THAT COME TOGETHER WITH THIS CCTAM

<table>
<thead>
<tr>
<th>Title</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoL</td>
<td></td>
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<tr>
<td>• Goat Raising</td>
<td>NAFES</td>
</tr>
<tr>
<td>INGOs</td>
<td></td>
</tr>
<tr>
<td>• Good Practice Note Goat Raising in Rural and remote Laos</td>
<td>CARE</td>
</tr>
</tbody>
</table>
Figure 2. Climate Change Adaptation in Goat Raising

Figure 2.1. Under free range system (left) goats are very prone to parasites and disease. Also, open lands for free range grazing are becoming scarce. A simple housing for goats (center and right) is an essential first step to reduce high mortality especially among the young. The housing should protect the young from heat, cold and wetness. Good ventilation is essential. With housing, it is also easier to conduct de-worming and vaccination.

Figure 2.2. Controlled grazing and tethering are slight improvements over free range system for feeding (left). The better way is to grow forage on farm and feed to the goats that are housed (right). This helps reduce parasite infection (under free range) and ensures the livestock manure is retained in the farm to support the farming system.
Figure 2.3. Young goats or Kids are very susceptible to parasites and disease (left). Uncontrolled grazing is one source of parasites for ruminants (center). Sucking colustrum (1st milk of the mother), early deworming and vaccination, penning, in addition to proper nutrition are key to low mortality.

Figure 2.4. To get the most out of native breeds, prevent inbreeding and select parents with desirable characteristics (left and center). If possible, plan the timing of breeding (right) so that kids are delivered towards the end of the wet season. At that time, they are less vulnerable to wet conditions and be prone to disease.
CLIMATE CHANGE ADAPTATION IN CHICKEN RAISING
3.0 CHICKEN RAISING

3.1 PHYSICAL PROTECTION OF CHICKEN

3.1.1 RATIONALE FOR THE ACTION

Chicken are sensitive to high temperature, long rains and strong winds, which have become increasingly unpredictable in the recent years. Chicken cannot sweat. They are also vulnerable to predators (hawks, rats, ants, etc.). To protect them from these elements, simple housing is needed. Housing also helps prevent disease outbreaks. Secured from life threatening events, chicken can better respond to improvements in nutrition and disease prevention and eventually grow faster and bigger and produce more eggs.

3.1.2 RECOMMENDED PRACTICES

a) Types of housing

- There are two basic types of housing recommended: “day and night housing” and “only night” housing. The “Night Only” housing, can be also placed in an enclosed free range.
- “Day and night” housing is preferred in regions with: a) High rainfall; b) year round crop production (protecting the crops from the birds, and densely populated peri-urban villages); and c) where farmers have easy access to commercial feeds and forage. Confining the chicken implies that the farmer needs to commit himself to provide adequate and balanced nutrition daily (energy, protein vitamins and minerals).
- “Night only” housing is housing where chickens can be confined during the night and where nests can be placed. It is often used in regions with: a) hot and dry climates and b) farmers have larger plots so that chickens can roam in the morning. In this type of housing, feeders and drinkers can be placed outside and the farmers have larger plots so that chickens can roam in the morning. In this type of housing, feeders and drinkers can be placed outside and measures to sell.

b) Basic requirements of housing design

The basic requirements are protection against extreme heat, wet conditions, strong winds and provision for natural light and fresh air. There are several designs recommended but the common good features of a chicken house made of locally available materials would include the following:

- Orient the chicken pen so that the sun does not directly hit the door and windows.
- Provide some shading for chicks that range outside the coop.
• Provide for electric fan if needed and if resources allow.
• Avoid overcrowding; if possible maintain a density of 1 chicken for every square foot.
• Look for signs of overheating – wings away from body, panting and lethargy and isolate affected animals.
• Provide for plenty of clean and fresh water on the waterer. At least 1 litter per 5 chickens.

Young chicks need to be confined until big enough, because they are prone to preying and being stepped. During cold weather, provide a light bulb to the chicks to serve as source of heat.

NAFES extension bulletin # provides further information on the raising of chicken including the housing of chicken.

3.2 BALANCED NUTRITION FOR CHICKEN

3.2.1 RATIONALE FOR THE ACTION

Proper nutrition directly contributes to a higher resistance of chicken from diseases. Most chicken raisers allow their chicken to free range. Natural food is usually available during the wet season. However, scavenging, especially among the chicks, exposes the animals to diseases. During the dry season, green feeds become constricting. Whether penned or free-range, there is a need to supply adequate and balanced nutrition to chickens.

3.2.2 RECOMMENDED PRACTICES

For chicken that are allowed to scavenge, supplemental sources of energy (maize, rice and cassava) would be important. Insects and worms are important sources of protein. Plant protein from cassava leaves, Leucaena, stylo and Arachis pintoi would be helpful especially for the small chicks. Supplemental sources of minerals such as crushed mollusc shells and eggshells (calcium) and burned and crushed bones (phosphorous) should also be provided.

For chickens that are permanently housed, more balanced commercial sources of feeds may have to be provided in addition to the green feeds above to ensure that special needs for protein, vitamins and minerals are supplied.

3.3 DISEASE PREVENTION

3.3.1 RATIONALE FOR THE ACTION

Chickens are susceptible to diseases. Variations in weather, especially long rainy periods or high temperatures affect birds. Cold and/or wet birds affect most chicks below 4 weeks old. At
the same time it is essential to be aware of the diseases that can be passed on to man. Disease resistance can be improved with better nutrition, housing, proper hygiene and vaccination.

3.3.2 RECOMMENDED PRACTICES

Housing and nutrition as measures that prevent disease are discussed in separate sessions. This section deals essentially with hygiene and vaccination.

a) Vaccination

- Follow a vaccination program particularly for critical diseases such as Newcastle disease, and Fowl Cholera.
- Conduct vaccination not only in one household but simultaneously for the neighbourhood and village.
- Ensure that purchased chickens have up-to-date vaccinations before mixing with the village flock.
- Vaccines are to be administered by authorized veterinary village workers.
- For scavenging chicken, it is difficult to catch them for vaccination. An alternative is to mix the Newcastle’s Disease vaccine with cooled, cooked, white, plain rice and spread the inoculated rice around the feeding grounds of the chickens.

b) Minimize exposure to stress as it lessens resistance to disease

- Protect from predators.
- Avoid sudden changes in living conditions.

c) Prevent the spread of disease

- Make sure that the newly acquired stock has been vaccinated.
- Quarantine newly acquired birds for 2 weeks before joining the brood.
- Prevent contact between birds and feces. If housing is on stilts with slatted floor, do not allow the chickens to go into the underside as they may eat the material from the house and spread disease.
- Maintain a clean environment (avoid feces mixing with the food and clean food and water containers daily and the pen regularly).
- Detect early signs of disease-fussy, isolated, teary eyed, loss of appetite.
- Quarantine diseased animals right away to avoid spread of infection.
- Bury or burn dead animals; avoid consumption.
- Wash hands after touching the poultry.
- Report occurrence of diseases and deaths to proper authorities.

The CARE publication entitled “Good Practice Note Goat Raising in Rural and remote Laos” provides good recommendations on disease control.
3.4 BREEDING MANAGEMENT FOR CHICKEN

3.4.1 RATIONALE FOR THE ACTION

Genetic traits that allow better climate adaptation especially among native breeds need to be conserved and used. At the moment, farmers prefer native breeds. To ensure that farmers would be able to benefit from these breeds, certain actions are needed to be done to ensure that parents with good qualities are bred to produce offsprings that has higher chances to adapt to harsh climatic conditions and less ideal husbandry practices.

3.4.2 RECOMMENDED PRACTICES

Native breeds are noted for their local adaptability. Bounthong Bouahom, et al. in behalf of MAF and FAO identified 5 native breeds and their characteristics (Table 3a).

- Kai Ou
- Black bone chickens,
- Kai Horn Chou
- Kai Yolk.
- Kai Chae

Table 3a indicates that the Kai Chae breed would have comparative advantage among the others in terms of hatchability and egg production. This breed was recorded to have a good mothering characteristic, which is good in increasing the number of chickens.

In order for the farmers to get the most from the native breeds, indiscriminate breeding should be avoided. Avoid inbreeding because it produces offspring with weak immune system or deformities. Change the cock every new generation to avoid inbreeding.

In selecting the right breeding stock for hens, choose those that are fast-growing and actively search for food far and wide most of the time. The physical features of such chicken are strong, short beaks and short toenails.

For cocks, select those that are fast-growing, with bright red and alert eyes and with large combs and wattles.
Table 3a. Native chicken breeds and selected characteristics.

<table>
<thead>
<tr>
<th>Breed/Characteristic</th>
<th>Kai Ou</th>
<th>Black Bone</th>
<th>Kai Horn C</th>
<th>Kai Yolk</th>
<th>Kai Chai</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of mature cock (kg)</td>
<td>2.7</td>
<td>2-2.3</td>
<td>1.3-1.7</td>
<td>1.5-1.8</td>
<td>&lt;1</td>
<td>Not too significant character unless used for meat</td>
</tr>
<tr>
<td>Weight of mature hen (kg)</td>
<td>1.6</td>
<td>1.5</td>
<td>1.2-1.5</td>
<td>1.3-1.5</td>
<td>0.8-0.9</td>
<td>Not too significant character unless used for meat</td>
</tr>
<tr>
<td>Egg production (eggs/hen/year)</td>
<td>55</td>
<td>76</td>
<td>70</td>
<td>56</td>
<td>78</td>
<td>High</td>
</tr>
<tr>
<td>Hatching capacity (%)</td>
<td>67</td>
<td>80</td>
<td>75</td>
<td>70</td>
<td>80</td>
<td>High</td>
</tr>
</tbody>
</table>

Source: Bounthong Bouahom et al, 2008. Indigenous chickens: an important part of rural livelihoods in Lao PDR

3.5 BENEFITS AND COSTS

The benefits would include reduced mortality especially among the young as the chicken will be more resistant to diseases. If the farmers can raise forage crops on farm and feed them to the chicken then the chicken will have more balanced nutrition. Native breeds will also be able to achieve their genetic potential with improved breeding management and better nutrition.

Most of the costs are similar to the labor costs under conventional practices. The incremental costs would include:

- labor and materials (mostly local) for chicken housing;
- labor for establishing and maintaining small plots of forage;
- better village level coordination to ensure more effective vaccination including the appointment and training of village veterinary workers;
- in the remote upland areas where vaccine is not readily available, additional time and effort for strict adherence to farm sanitation and other related preventive measures;
- more time attention to prevent inbreeding, select good parents, and manage the breeding process.
3.6 APPLICABILITY IN IRAS PROJECT SITES

The recommended practices are generally applicable in IRAS project sites depending on the remoteness from urban areas and sources of important inputs such as supplemental commercial feeds and vaccines. In the more remote upland areas of northern project sites, limited access to commercial feeds means more attention to the production of on-farm leguminous forage. Special arrangements are also needed to make important vaccines (with low temperature requirements) available to the entire neighbourhood, if not in the village.

3.7 COMPANION MATERIALS (LOCAL EXTENSION MATERIALS) THAT COME TOGETHER WITH THIS CCTAM

<table>
<thead>
<tr>
<th>Title</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease Prevention For Poultry</td>
<td>NAFES</td>
</tr>
<tr>
<td>Traditional Chicken Raising</td>
<td>NAFES</td>
</tr>
<tr>
<td>A Manual On Improved Rural Poultry Production</td>
<td>NAFRI – FAO</td>
</tr>
<tr>
<td>Indigenous chickens: an important part of rural livelihoods in Lao PDR</td>
<td>NAFRI – FAO</td>
</tr>
<tr>
<td>Good Practice Note Village Chicken Raising in Rural &amp; Remote Laos</td>
<td>CARE</td>
</tr>
</tbody>
</table>
Figure 3. Climate Change Adaptaion in Chicken Raising

3.1 Chicken are sensitive to high temperature, wetness and cold weather. Housing is critical to protect them from weather aberrations and predators. It prevents the spread of disease and provides safe and sanitary place for egg production.

3.2 Night housing (left) in an enclosed range allows the chicken to scavenge in the day and be confined at night for protection. On the other hand, the transportable chicken house (right) does not have a floor and allows chickens to find feed in the fields without getting lost. Every day the pen is moved to a different place in the field. Source: Oosterwijk, G. Et al 2003. A Manual on Improved Rural Poultry Production MAF.
Figure 3.3 Chicken particularly the young require high energy, protein vitamins and minerals. It is important to have elements from different feed sources to encourage high intake. The diverse food sources can be obtained from the farm especially if there is a forage lot. (Source: Oosterwijk, G. Et al 2003. A Manual on Improved Rural Poultry Production MAF).

Figure 3.4 Part of protein needs can be supplied by insects, concentrates and green feeds. Leafy Legumes such as Stylo 184 and Leucaena leaves as well as grain legumes can be very good source of plant protein.
Figure 3.5. The Kai Chae chicken is one of the 5 naive breeds recorded. They are widely distributed; well adapted to the environment and easy to raise. They have high annual egg production of about 78 eggs, while their hatching capacity is 80 percent. Their mothering qualities are excellent. The breed is famous for its high-quality meat (Source: Bounthong Bouahom et al., 2007. Indigenous Chickens: An Important Part of Rural Livelihoods in The Lao Pdr (FAO Working Group On Biological Diversity, FAO).

Figure 3.6. Avoid inbreeding. Exchange cocks every new generation to avoid parents breeding their offspring. Select parents with desirable qualities (center and right). For example, among hens choose those with sturdy legs and spends time to look for food (short beaks). For cocks choose the more active ones. (Source: Oosterwijk, G. et al. 2003. A Manual on Improved Rural Poultry Production MAF).
CLIMATE CHANGE
ADAPTATION IN
ON-FARM FORAGE RAISING
4.0 ON-FARM FORAGE RAISING

4.1 RATIONALE FOR THE ACTION

Green feeds are important sources of nutrition in many rural areas where commercial feeds are expensive and not readily accessible. The traditional practice of grazing and scavenging, plus supplemental feeding with green feeds is becoming difficult. Open and unclaimed lands have become scarce. During the long and extended dry seasons, natural sources of feeds are less available.

Also, as the farm family spends more time in crop production adaptation to climate change, the time spent for searching green fields daily and bringing animals to distant grazing areas are lessened. Given this challenge, farmers may opt to grow forage on-farm. By doing so, farmers can ensure good nutrition and productive growth of animals including reduction of time needed to produce marketable animals. These benefits enable the farmer to have more hours to incorporate adaptive measures in the farming systems.

4.2 RECOMMENDED PRACTICES

4.2.1 Feeds, forages and planting schemes

Pigs, goats and chickens all need supplemental sources of good quality protein, carbohydrates and vitamins and minerals. These could be attained from the following:

- Rice, corn, root crops and crop residues
- Commercial feeds
- Naturally occurring grasses and improved grasses e.g. Gamba, Marandu, Signal, etc.
- Grain legumes (pigeon pea, rice beans, soybeans, stylosanthes, etc.) which can be grown as intercrops or relay crops or short fallow crops
- Leguminous trees – examples are *Leucaena leucocephala* or *Gliricidia sepium*, which can be grown as living fences

Green feeds can be grown on farm. Given the small size of the farm, production of forage crops must be made in such way that it will not compete with staple crop production. Having this in mind, forages may then be grown in various ways.
Table 4a. Various ways of raising forages.

<table>
<thead>
<tr>
<th>Planting Scheme</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut And Carry Plots</td>
<td>small plots near animals that are housed all the time or at night</td>
</tr>
<tr>
<td>Grazed Plots</td>
<td>small fenced plots that animals can graze occasionally (sick animals or lactating animal)</td>
</tr>
<tr>
<td>Living Fences</td>
<td>lines of medium sized leguminous trees around the farm or house</td>
</tr>
<tr>
<td>Contour Hedgerows</td>
<td>forages grown along the contours and in between strips of crops</td>
</tr>
<tr>
<td>Improved Fallows</td>
<td>grown in land that is left under fallow for one or more seasons</td>
</tr>
<tr>
<td>Cover Crops Under Trees</td>
<td>legumes grown under tree crops</td>
</tr>
</tbody>
</table>

Source: CIAT, 2001

4.2.2 Recommended species and varieties

In 2005, out of 152 varieties evaluated, the NAFRI and NAFES with CIAT assistance identified the top 10 forage species and varieties broadly adapted to Lao climate and environment.

Table 4b. Forage species and varieties broadly adapted to Lao climate and environment.

<table>
<thead>
<tr>
<th>Promising varieties for possible introduction throughout Laos</th>
<th>Evaluation sites (provinces and districts)</th>
<th>Oudomxay</th>
<th>Luangprabang</th>
<th>Luangprabang</th>
<th>Vientiane Capital</th>
<th>Champasack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasses:</td>
<td></td>
<td>Xay</td>
<td>Xiengngeun</td>
<td>Luangprabang</td>
<td>Naxaithong</td>
<td>Khong</td>
</tr>
<tr>
<td>“Gamba” (Andropogon gayanus)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>“Marandu” (Brachiaria brizantha)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>“Signal” (Brachiaria decumbens)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>“Tully” (Brachiaria humidicola)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>“Ruzi” (Brachiaria ruzizensis)</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Jarra” (Digitaria milanjiana)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Table 4c. Forage species recommended for uplands.

<table>
<thead>
<tr>
<th>Species</th>
<th>Positive features</th>
<th>Special considerations</th>
</tr>
</thead>
</table>
| "Marandu" (Brachiaria brizantha) | * Tall grass suitable for cutting  
                                    * Grows in moderately fertile, acid soils  
                                    * Stays green during dry season  
                                    * Produces more seed than "Basilisk" (Brachiaria decumbens) | * Not to be fed to goats, sheeps and young cattle (photosintization) |
| "Mulato" (Brachiaria hybrid)  | * A cross between 'Marandu' and 'Ruzi'  
                                    * Produces fertile seed  
                                    * Establishes rapidly from tillers  
                                    * Grows well in the dry season  
                                    * Produces better quality feed than other Brachiaria varieties | * Needs at least moderate soil fertility  
                                    * Low seed production |
| "Simuang" (Panicum maximum)   | * Tall grass suitable for cutting  
                                    * Produces high quality feed  
                                    * Generally suited to more fertile soils | * Must be fertilized regularly to maintain high productivity  
                                    * Stemmy if not cut regularly  
                                    * Not suited for long dry seasons |
| "Stylo or CIAT 184" (Stylosanthes guianensis) | * An erect, short-lived (2 or 3 years) perennial legume  
                                    * Grows on low fertility and acid soils  
                                    * Produces large quantities of good quality feed for cutting  
                                    * Stays green in dry season  
                                    * Leaves can be fed fresh or dried and stored as leaf meal | * Needs to be planted by seeds  
                                    * Cannot tolerate heavy grazing or frequent cutting |

Source: NAFRI and NAFES, 2005. Forage Options for the Lao Uplands

In addition, certain promising species were also identified for their adaptability to certain conditions:
Table 4d. Additional promising grass and legume varieties.

<table>
<thead>
<tr>
<th>Species</th>
<th>Unique beneficial features</th>
<th>Special consideration</th>
</tr>
</thead>
</table>
| Gamba (*Andropogon gayanus*) | * Tolerates infertile and acid soils  
* Stays green into the dry season            | --                                                                                     |
| Basilisk (*Bracharia decumbens*) | * Tolerates infertile and acid soils  
* stay green into the dry season  
* Maybe cut and use for grazing       | * Should not be fed to goats, sheep, or young cattle                                    |
| Terenos (*Paspalum atratum*)     | * Grows well on fertile, acid soils but only in wetter areas, without an extended dry season | --                                                                                     |
| Solander (*Setaria sphacelata*)   | * Grows well in cooler areas  
* Should not be fed to horses            | * Requires soils with good moisture and fertility                                      |
| Retalhuleu(*Gliricidia sepium*)  | * May provide high quality protein supplement to grass-based diets  
* Can be planted from stem cuttings  
* Useful as living fence  
* Can grow on moderately acid soils at lower elevations  
* Produces leafy forage during dry season | * Initially not very palatable to cattle, but over time they learn to like it           |
| Besakih (*Calliandra calothyrsus*) | * Provides high quality protein supplement to grass-based diets  
* Grows on acid soils in cooler areas  
* Leaf yields are high with properly managed cutting  
* Provides good firewood                      | * Must be planted by seed and initial growth is slow  
* Leaves are only palatable when freshly cut.                                         |

Source: NAFRI and NAFES, 2005. Forage Options for the Lao Uplands

Other good sources of energy and protein may also be established as part of the forage plots. These include cassava tubers and cassava leaves, sweet potato and peanut meal.

Special considerations (indicative list)

- Species that withstand long dry seasons are: *Leucaena leucocephala*, *Gliricidia sepium*. Grasses such as *Andropogon gayanus* and *Stylosanthes hamata*.
- Species for areas that are burnt regularly (can regenerate after fire): *Stylosanthes guianensis*, *Centosema pubescens* and *Leucaena leucocephala*.
- Species that can withstand a few days of water logging: *Brachiaria mutica*, *Macroptilum gracile* and *Codariocalyx gyroides*.
- Species for acidic areas: *Stylosanthes guianensis*, *Brachiaria humidicola*.
- Species for alkaline soils: *Desmanthus virgatus*, *Brachiaria humidicola* and *Leucaena leucocephala*.
- For monograstrics (pig and chicken) the amount of legume should not be more than 10% of the diet because these animals are incapable of breaking down mimosine.
• Certain species of Brachiaria such as B. brizantha, B. ruzisiensis and B. mutica should not be fed to goats, sheep and young cattle.

4.2.3 Establishing and maintaining the forage sources

Grass production will require vegetative planting materials such as tillers and stolons. Grass seeds can also be grown but usually have low germination (up to 40%). Legumes are mostly grown by seeds. Many of the suitable leguminous trees asexually propagated.

Vegetative planting materials may be obtained from other farmers where there are previous or existing projects promoting improved forage systems or from the PAFO and DAFO who can facilitate procurement from recognized seed producers.

A 10 x 20 square meter lot can support the year round forage needs of 5 to 6 goats. If raising pigs and chicken only, smaller plots would be needed. Pigs for instance, require not more than 10% of their daily intake in the form of fresh green leaves. A 20 kg pig will need 500 grams of fresh stylo. Young pigs though, can consume protein up to 30% of their daily intake. There are no hard and fast rules on plot size or number of trees because this has to adjust to the actual area that the farmer can devote without jeopardizing food production.

Forage grasses need to be cut regularly. The best time for cutting would depend on the need of the farm operations. If there are lactating does and young animals that have high protein requirements grasses can be cut young to produce high protein forage. If the farm operations need more bulk, the grasses may be cut at a later time. In general, it is recommended to cut the grasses between the period of leaf growth stage and rapid leaf and stem growth.

Grasses may be cut in between 5 to 30 cm from the ground, while for short legumes it may be cut from 5 to 10 cm from the ground. Shrubs and tree legumes are cut in between 50 to 100 cm height.

4.2.4. Maintaining soil fertility

Forage production requires a lot of nutrients. Grasses consume large amounts of nutrients since the whole plant is usually used. Penning the animals is an important first step to ensure that the farm gets the manure for its needs. The design of the housing should include slatted floors so that animal waste is directly dropped to the ground for collection. Manure from animals must be collected regularly and used partly for crop (vegetables, fruits, etc.) and forage production.

A step by step instruction for identification, production and maintenance of forages could be obtained from the CIAT publication entitled Developing Forest Technologies with Smallholder Farmers.
4.3 BENEFITS AND COSTS

On-farm forage production is the foundation in ensuring small livestock is able to obtain most if not all the forage needs through the year. Without on-farm forage production, penning is not advisable because the livestock may be underfed. Without penning, farmers run the risk of their free range animals catching parasites and disease, damage to crops and the possibility of livestock loss. The farm also loses the manure, which is important in soil productivity.

Establishing and maintaining the forage lot will involve additional labor costs and the cost of planting materials particularly of improved grasses and legumes. The amount of labor, however, may be compared to the labor involved in daily search for green feeds if a forage lot were not maintained.

In the end, the additional investment in labor and materials for forage lots should be compared to the costs if it is not practiced. These costs include the high incidence of parasitism, disease infection in animals and mortality; crop damage and the foregone value of manure that could not be used for the farm.

4.4 APPLICABILITY IN IRAS SITES

On-farm production of forage lots is technically viable in all IRAS sites. The main limitations would be certain varieties of grasses and legumes, which may not be suited to location-specific soil conditions such as pH. The previous discussion identifies the species and varieties that may suit to the different site level conditions.

Farmers in peri-urban areas and with limited land area, may prefer to avail commercial feeds instead of forage lots because of the opportunity cost of labor. They also have no compelling need for manure as these can be supplied by commercial fertilizers. The exception would be the farmers who tend to apply organic agriculture interventions. Farmers in remote rural areas are more likely to adopt these to ensure additional protein sources.

4.5 LOCAL EXTENSION MATERIALS THAT COME TOGETHER WITH THIS CCTAM

<table>
<thead>
<tr>
<th>Title</th>
<th>Source</th>
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<tbody>
<tr>
<td>INGOS</td>
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<tr>
<td>Developing forage technologies with small holder farmers No 88</td>
<td>CIAT</td>
</tr>
</tbody>
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Figure 4. Raising Forages On-Farm

Figure 4.1. A forage lot (also referred to as fodder bank) is a land where forages are grown in an intensive way. A 10 x 20 m² area of forage can support 5 heads of goats throughout the year.

Figure 4.2. Forage lots however need not be in one contiguous area. It can also be in the form of a biological fence (left) or as hillside hedgerows that also prevent soil erosion.
Figure 4.3. After establishment, do not cut the grasses for the first time before eight weeks and the trees before 12 months. Then you can cut the grasses once every four to six weeks and the trees once every two to three months, depending on the rainfall. Cut the tree branches at about 1 metre from the ground and the grasses slightly lower at 75 cm. (Source: NAFRI, NAFES Publication Improving Livelihoods in the Uplands)

Figure 4.4. Since most of plant parts of the forage are used, they can consume a lot of the natural fertility of the soil. To maintain soil fertility, make sure that part of the manure from animals is used to fertilize the forage lot so that the farming system does not lose its supply of nutrients.
5.0 PHASING THE IMPLEMENTATION OF TECHNOLOGIES

The practices and technologies for climate change adaptation cited above are applicable in varying degrees in the IRAS project sites. However, location specific conditions at the district level may require that some technologies be immediately implemented, while others may be implemented at a later time. Such conditions would include the following:

- Access to open forage areas and sources of natural feeds
- Access to commercial feeds and vaccines
- Relative exposure of communities to certain technologies;
- Level of skills, level of risk taking of the community
- Availability of planting materials and
- Some financial resources for procurement of materials or hiring supplemental labour.

The following criteria may be used to identify those technologies that can be done immediately (Year 1).

- Local communities already have some exposure to the technology;
- Does not require major changes in animal raising practices that require new and relatively complex skills;
- Do not require a lot of time and money to acquire materials or equipment;
- Can provide immediate protection or adaptation to physical hazards e.g. high temperatures, cold fronts or extended wet periods.

Based on these criteria, the following technologies can be implemented immediately while others can be done in succeeding years.

Table 5a. Proposed phasing of application of technologies.

<table>
<thead>
<tr>
<th>ACTIONS IN YEAR 1</th>
<th>ACTIONS IN SUCCEEDING YEARS</th>
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<tbody>
<tr>
<td><strong>Protection from extreme weather</strong></td>
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<tr>
<td>• Providing ample supply of water</td>
<td>• Day and night housing for animals with proper ventilation, drainage, feeding trough and water nipples</td>
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<tr>
<td>• Providing for shade during hot days including trees</td>
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<tr>
<td>• Day and night housing for young chicks</td>
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<tr>
<td>• Night housing for animals (in places where free range is the custom)</td>
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<tr>
<td>• Slight improvements of existing housing for proper ventilation</td>
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<tr>
<td><strong>Nutrition</strong></td>
<td><strong>Preventing disease</strong></td>
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<td>-------------------------------</td>
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<tr>
<td>• Establish small plot of Stylo 184 and incorporate in existing feeding system</td>
<td>• establish on farm forage lot of grasses and legumes</td>
</tr>
<tr>
<td>• If there is access to commercial feeds, supplement fibrous feeds of pigs</td>
<td>• Convert stylo 184 biomass to leaf meal for better consumption among young animals</td>
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<tr>
<td>• Regular supply of salt for goats</td>
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<tr>
<td></td>
<td>• Ensure young animals suck the colostrums (first milk) of pigs, and goats for better resistance</td>
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<td></td>
<td>• Practice overall farm sanitation and preventive measures (e.g. feces is away from feed etc)</td>
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<td></td>
<td>• Among goats on free range, time their trips to late morning to avoid catching parasites</td>
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<td></td>
<td>• De-worming for penned animals. Un penned animals can be easily reinfested.</td>
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<td></td>
<td>• If vaccines are limited, focus administration on young animals and mother animals (sows, does, hens)</td>
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<td></td>
<td>• Follow a simultaneous vaccination program for the entire village</td>
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<td></td>
<td>• Arrange for regular services by village animal veterinary workers</td>
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<tr>
<td></td>
<td><strong>Breeding management</strong></td>
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<tr>
<td>• Prevent inbreeding</td>
<td>• Practice selection of good quality parents</td>
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<tr>
<td></td>
<td>• Time the breeding of goats so that kids are born at the end of the wet season</td>
</tr>
</tbody>
</table>
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