

Comments on Introductory Paper

From: Jeroen Dijkman (AGAP) <Jeroen.Dijkman@fao.org>

Comment on introductory paper

Whereas I fully agree with the sentiments and desires expressed in both the introductory and second paper, I would like to raise a number of issues relating to the points made thus far.

It has been (rightly?) argued that, ideally, farming methods should be sustainable on all levels. What this actually means in practice (and what do we use for our baseline?) and how one assesses it (or dare I say, measure it) is a completely different proposition. As far as I am aware, but I stand to be corrected, there has been no significant work done on the establishment of actual practical indicators of the various levels of sustainability other than 'what they could be'. In the current research funding-climate I do not see anyone making the needed long-term commitment that will change this situation, either.

The next immediate question, which was raised in the first paper, is time.

But what time-scale do we talk about? Five, 10, 30, 100 years? And can we be sure that if something appears to be 'sustainable' for 5 years that this will still be the case in 25 years time?

There are, in my view, also more inherent dangers to the application of any set time-scale to both the development of indicators and the interpretation of trends and results in general. This is probably best illustrated for the 'pasture-tree systems in arid or semi-arid savannah'. In these systems the carrying capacity concept has long been used as the scientific standard against which rangelands were judged to be overgrazed, and to prove that pastoralism, as practised in the majority of the world's rangelands is inherently inefficient and environmentally destructive (e.g. Hardin, 1968; Lamprey, 1983). Long-term research has shown, however, that severe droughts are integral part of the long-term dynamics in Africa. Some evidence indicates a climate induced movement of the Saharan vegetation belts, but there is no evidence to substantiate the claims that grazing livestock are a major causal agent. Frequently,

areas perceived as degraded due to the over-exploitation by pastoralists, quickly recover as soon as the rains return. Nevertheless, the portrayal of pastoralists as instigators rather than victims, and the assumption of livestock induced desertification and rangeland degradation as a basis for research, has made policy makers and international organisations move away from pastoralists rangeland development issues (e.g. Sandford, 1983; Ellis and Swift, 1988; Behnke and Scoones, 1993). I think that we stand to make similar mistakes in other systems if we move without properly understanding their dynamics. Moreover, I think that we are, again, in danger of pointing the finger of accusation at small-scale farmers.

In principle, of course, there is nothing wrong with farmers burning down a patch of rainforest and cultivating it until it is exhausted. From their point of view it may even be the most beneficial option. There are still a fair number of places where there is still enough new land. On a global basis, the actions of these farmers probably have much less influence than any large-scale commercial logging or mining operation, and it are the greater political issues that form the root-causes to a number of these problems that need to be addressed.

So the next question is 'sustainability for who' and more to the point for 'whose benefit'? Of course we should be thinking about the design of sustainable options that provide people a secure and good long-term income so they can afford a reasonable standard of living, but in many instances it may be more profitable to take the quick 'easy' money and run. In addition, whereas we have the relative luxury being able to contemplate the next 25 years or so of our existence, such considerations may not be foremost in the mind of a person trying to find an income/meal for the day. In many cases people are well aware of the long-term implications of their actions, but they still have to survive today.

At a more practical level of course, there are a number of other important issues related to the establishment of so called 'sustainable systems'. In many cases the establishment of these models takes a good number of years (e.g. perennial trees may take a long period to bare fruits). The models, therefore, need to be designed in such a way that the

farmers also have a good income throughout this 'establishment' period. I know there have been some 'successful' pilot experiments, but can we be sure that experimental (small-scale) models actually translate to the 'scaled-up' real world?

In addition, there is the issue of land-tenure. Dr. Dolberg mentioned land-less farmers and in the same way people who 'share-crop' or farm on rented land should be included in the discussions. Quite often the tenancy agreements are such that any establishment of more longer term or more 'sustainable' measures are of no actual interest to the tenant.

There are of course numerous other points, but I am sure I have rattled on long enough by now. There is, however, one final comment I would like to make. I have no doubt that the studies reported in the second paper were carried out properly, but I do think we need to ask ourselves 'who is asking the questions' and with 'what purpose'. I have participated in a number of PRAs and too often the solutions identified by the 'community' are, basically, what the researchers had in mind at the onset of the PRA. Whereas there may be nothing wrong with that in principle, I do think we have to remain self-critical and open minded. Nowadays it seems that as long as we do things 'participatory' no further questions need to be asked.

From: Andrew Speedy <speedy@ermine.ox.ac.uk>

Reply to Comments from Jeroen Dijkman:

I will let others comment more fully on some of your points. 'Indicators of sustainability' is a buzz-phrase and you are right to highlight the time scale. But measurements can be made. Soil, biomass production, input-output studies... Who is doing this and who has some data??? Over time, the system must be adaptable, especially if local and wider markets change. This must be a feature of the system. Adaptability to climate variations is another point. Many of the savannah systems are vulnerable because they do not include trees (which are deeper rooting and withstand drought). These were present in the natural system before pasture 'improvement'. But again concerning the question about sustainable grazing systems using common lands??? Can anyone cite successful

examples. CIAT? ILRI? ICRISAT?

On an optimistic front, there are good results with establishment of fodder trees (*Leucaena*, *Gliricidia*, *Erythrina*) in 2 years in tropical regions. CIPAV have data! (CIPAV please comment!). Again, here is an opportunity for people to contribute hard data. I am struck by the lack of DM production data even on these popular species.

I have posed a number of further questions. It is hoped that participants will feel very free to add comments. Certainly we should not be complacent about results of participatory work and systems studies. What is clear from the literature (or lack of it) is that we need hard data.

That has been said several times. Here is the opportunity to 'publish' results!

Jeroen Dijkman, FAO (AGAP)

**From Lylian Rodriguez ,lylian@sarec.ifs.plants@ox.ac.uk>
Comments on introductory paper**

I am Lylian Rodriguez a Colombian working in an NGO-CIPAV in Colombia and studying and working in Vietnam for the past two years. I would like to comment in some points raised for some participants.

1.Regarding the introductory paper: Livestock Feed Resources Within Integrated Farming Systems. A.W. Speedy, C. Dalibard and R. Sansoucy, FAO Rome.

"In this first conference, the evaluation of the nutritive value of tropical feeds for ruminants was reviewed by Leng (1996) and extensively discussed by the participants. To summarize, there are many data on the chemical analysis and calculated nutritive value of animal feeds but the emphasis has been on grains and supplements used in temperate systems. Far fewer data exist on the less conventional feeds and forages, especially those found in the tropics."

I think the question is not only about the availability of information but also which are the appropriate analyses to do in order to assess the nutritive value of tropical feeds? A lot of work has been done analyzing

hundreds of samples and hundreds of items but, in the end, how does it benefit the development of feeding systems? Another question is how to develop simple techniques that would be suitable under difficult conditions? We may come to the conclusion that not many analyses are needed to assess tropical feeds and that a combination between simple technics and feeding trials having the animal as the best laboratory is the best approach.

"Multinationals have now taken over control of the system, and many developing countries are caught in the vicious circle of requiring commercial production to generate the hard currency needed to pay for the inputs."

In Vietnam News September 2, 1995 an article "Wars do not end Conflicts", Hari Chathrattil wrote: "The failure of the Green (agriculture), the Blue (aqua culture) and the White (dairy farms) Revolutions in India to bring about any degree of parity between the rich and the poor is eloquent testimony to the non applicability of the industrialization process. All these revolutions depend on modern technology and not on people. Ultimately the target beneficiaries of all this development -poor people- are left in the lurch."

"Agricultural education and training in both the developed and developing world put much more emphasis on specialization than on integration. Institutions separate crop and animal production at all levels (extensionists, researchers and decision makers), and the two groups ignore each other and struggle separately for power and budgets. They develop separate projects instead of cooperating with each other and exploiting the benefits of integration."

A change in the method of education is fundamental. The world needs sustainable education. Are we new professionals ready to work towards a suitable approach? It is difficult when traditional teaching is focussed on technological packages as a consequence of the green revolution and when the major objective is to train people to work for the multi-national enterprises, to sell concentrates or medicines or pesticides.

The professionals involved in the education system need to create a

deep and wide conscience about appreciating the real situation facing poor farmers and what needs to be done in order to promote truly sustainable agricultural systems and to try to understand these issues.

My BSc is in Animal Husbandry and, when I was at the university, I did not have the opportunity to learn even about "forage trees" It wasn't anywhere in the curriculum!! But we had to learn about how to cultivate grasses like King grass and so on. Just an example!! Many of my classmates are working with multinationals!! That was in Colombia but the situation in Vietnam is similar near to the cities like Ho Chi Minh where there are some big enterprises. But in the remote areas the situation is even worse because day by day there are less people who want to study agriculture. Why is it happening? Maybe because what they are learning at the universities is not that farmers need!! The change must be at pre and post graduate level. We need change in many aspects!!

2. About Jeroen Dijkman's comments:

"In principle, of course, there is nothing wrong with farmers burning down a patch of rainforest and cultivating it until it is exhausted. From their point of view it may even be the most beneficial option. There are still a fair number of places where there is still enough new land. On a global basis, the actions of these farmers probably have much less influence than any large-scale commercial logging or mining operation, and it are the greater political issues that form the root-causes to a number of these problems that need to be addressed. - So the next question is 'sustainability for whom?' and more to the point for 'whose benefit'? Of course we should be thinking about the design of sustainable options that provide people a secure and good long-term income so they can afford a reasonable standard of living, but in many instances it may be more profitable to take the quick 'easy' money and run. In addition, whereas we have the relative luxury being able to contemplate the next 25 years or so of our existence, such considerations may not be foremost in the mind of a person trying to find an income/meal for the day. In many cases people are well aware of the long-term implications of their actions, but they still have to survive today."

I agree and I therefore believe that the approach must be more global "to develop sustainable systems of production" and we should involve credit in development but suitable credit for the poor people, for those landless that don't have any other way to get timber, fire wood to sell and for cooking and for those who have to burn forest to plant something to get the food for today but don't know what will happen tomorrow. But if there are appropriate strategies combining, credit, appropriate technology, research, extension and again appropriate education development could be more solid and sustainable.

We had the opportunity to visit Bangladesh recently with a Vietnamese colleague and we could see how the institutions such as Grameen bank and BRAC and other NGOs are having a very big impact on people (Grameen Bank with 2 million members and BRAC 1.6 million) and with high involvement of the community. They provide suitable credit for the poor where they are not asked for collateral to borrow money and where they start with small loans and people invest it according to their own skills so they usually diversify activities. We could see that the role of livestock is very important, especially poultry for the poorest of the poor and certainly the access to appropriate credit has been a change in their lives.

"There are of course numerous other points, but I am sure I have rattled on long enough by now. There is, however, one final comment I would like to make. I have no doubt that the studies reported in the second paper were carried out properly, but I do think we need to ask ourselves 'who is asking the questions' and with 'what purpose'. I have participated in a number of PRAs and too often the solutions identified by the 'community' are, basically, what the researchers had in mind at the onset of the PRA. Whereas there may be nothing wrong with that in principle, I do think we have to remain self-critical and open minded. Nowadays it seems that as long as we do things 'participatory' no further questions need to be asked."

It is a very interesting point!! Certainly Participatory Rural Appraisal has become a "fashion" and, as you said, in most cases the answers or the results of those activities are the answers that the outsiders are expecting.

In our work, we had to change our objectives according to the farmers' ideas and that was how we came to the local breeds of pigs. Participation is a mutual learning process where "outsiders", local authorities and farmers can increase their awareness of what to do to achieve change. But what is true participation? There are many kinds of participation from passive participation, where people are involved merely by being told what is to happen, to self-mobilization, where people take initiatives independently of external institutions (Pretty 1995). Through our project activities, it has been shown that participation is also a learning process, based principally on confidence among outsiders and the target group.

Regarding the project, it may give you a more clear idea by quoting one of the conclusions: In this project there was a clear example in how do we "outsiders" think about "appropriate technologies" (Chambers, 1983) to be applied at village level and the result was a "learning" from farmers and the project changed from, milk production as an additional purpose for the local cows to biodigesters to duck weed as a source of protein to local breeds on pigs and, finally, to get an overall view of the socio-economic situation of the village. Definitely it is a way to really, but not completely, understand the village situation. There must be an active process where outsiders try to understand the situation, offer alternatives which may have some impact in the village, using an iterative process of trial-error (Dolberg, 1994) and villagers participate actively making criticisms and suggestions to the outsiders, giving ideas which may change the researcher's objectives. The starting point must be around this approach, it can not be achieved only with participation in information giving (Pretty 1995) where people participate by answering questions posed by extractive researchers using questionnaire surveys or similar approaches and people do not have the opportunity to influence proceedings. What agriculture needs is a willingness among professionals to learn from farmers.

3. Regarding Andrew Speedy comments:

"On an optimistic front, there are good results with establishment of fodder trees (Leucaena, Gliricidia, Erythrina) in 2 years in tropical regions. CIPAV have data! (CIPAV please comment!). Again, here is an

opportunity for people to contribute hard data. I am struck by the lack of DM production data even on these popular species."

Yes, in the case of Colombia, a lot of work has been done in the use of forage trees such as *Gliricidia*, *Leucaena*, *Erythrina*, *Trichanthea gigantea* with medium and small scale farmers and there are results for almost 10 years. In this system trees such as *Gliricidia sepium*, *Leucaena leucocephala* and *Erythrina fusca* are planted at densities in the range 600 to 1100/ha (*E. fusca*), 10,000 to 20,000 (*G. sepium*, *L. leucocephala*) and 25-50/ha (*Prosopis juliflora*), in association with grasses such as Star grass (*Cynodon nlemfuensis*) and Argentina grass (*Cynodon dactylon*). The trees are lopped at intervals of 90-120 days in the case of *E. fusca* and *G. sepium*, browsed at intervals of 40-60 days for *L. leucocephala* or left for the fruits to fall and be consumed in situ or collected (*P. juliflora*).

I was working in a medium scale integrated farm in Colombia where there is a silvopastoral system involving *Erythrina fusca* and star grass and there are two fields that were planted from a combination of cuttings and seed. The first had an area of 1 ha, with 1,102 trees at distances between them of 3m. The second was 9,913 m², with 512 trees at a distance of 4m between trees. The original vegetation in both fields was African Star grass which quickly re-established itself to form a stable association with the trees. Management consisted of rotational grazing with 6 divisions in each area using electric fences. Occasionally the milking herd of dual purpose Holstein-Zebu F1 cows grazed the pasture but mainly this was with calves both pre- and post-weaning. The foliage of the trees was cut from branches 2m above ground level. The first harvest was 16 months after planting and subsequently at 3-4 month intervals. The shade effect of the trees ranged from zero, immediately after harvesting, to 100% after 3-4 months of regrowth when the next harvest of the foliage was due.

Estimations of biomass production of the star grass (by cutting 1 m squares prior to grazing) were of the order of 90-100 tonnes/ha/year. The mean yields of erythrina foliage were: 13.3 and 15.7 kg/tree/harvest for the 3*3 and 4*4 spacings, respectively. Annual yields averaged: 51 and 28 tonnes fresh foliage/ha/year. With these yields it was estimated that

the legume foliage used as a supplement (9 kg/day for animals of 300 kg live weight) would support 8-13 animals/ha/year; and that the capacity of the pasture was 3 animal units (400 kg live weight)/ha/year. More information available in (Cuellar Piedad, Rodriguez Lylian and Preston TR) in LRRD 8.1.

I hope my friends in Colombia will add more information.

Lylian Rodriguez

From: Chedly Kayouli (Tunisia) <101763.2164@compuserve.com>

Comments on Introductory Paper

Integration vs. Specialization...

1: Several formerly colonized countries which have replaced the traditional farming system by large scale commercial productions that has been encouraged by the old colonial powers are nowadays living through the drama of the so-called New World Economic Order and many products are not competitive for export; furthermore some crops have impoverished the soil.

2: As the majority of education programs in developing countries are inspired by those of developed countries and have opted for specialization, many institutions in Third World countries are still unfortunately unaware and continue to implement specialized agricultural projects. I trust that the recently establishment of the University for Tropical Agriculture Foundation (UTA Foundation) in Ho Chi Minh City will help many young scientists and researchers in acquiring a new educational program on the benefits of sustainable tropical livestock-based agriculture.

3: What about the vicious circle and the equation: Food Security + Sustainable management of resources = Improving welfare of rural poor.

I think that Food Security is a utopian notion of the end of this century and perfectly illustrates the failure of most agricultural projects in developing countries and particularly in Africa, implemented by international agencies and local governments. It is surprising to observe again in the emergency programs the same errors as those committed

earlier:

First: Demographic pressure is a major cause threatening food security; human population in Africa had increased from 238 million in 1950 to 665 million in 1993. So what has been done to slow down the population growth rate?

Secondly: The Third World is facing too many different sources of food insecurity: low carry-over stocks of grain, less arable land, unsustainable use of land and water, cumulative effects of soil erosion and other forms of environmental degradation, and severe frequent drought. These are the major problems, while almost all new food security programs put much more emphasis on the use of chemical fertilizers and higher yielding cereal varieties. The cultivation of cereals (wheat, rice, maize, millet..) is seen by many people as the primary activity in the farming system to ensure food security and they often ignore the role of livestock for food security for almost all farm families in developing countries as:

(i) an important food source (e.g. in Third World pastoral communities)
(ii) a source of income and generator of employment (mainly in North Africa, the Saharan zones, the Middle East, the Central Asian Republic...)

(iii) a supplier of production inputs: in many low-income countries, animals are the main source of (1) draught power (transport sector, crop cultivation...) and (2) fertilizer: Nitrogen fertilizer plays a key role in improving soil fertility. In this respect manure is considered an essential input to increase crop production. Recently in Laos and Niger, we have recorded a meaningful increase of between 15 to 24% per hectare of paddy rice and millet when farmers spread manure from animals fed urea treated rice straw (because of its higher nitrogen content) than when they use that produced by animals fed untreated straw.

Therefore, decision makers and institutions should be aware of the key impact of animals to promote and strengthen the capability of farmers to run an integrated Livestock-Agriculture system and improve food security.

Comments on Integrated Farming System

Here I share the same ideas presented by Jeroen Dijkman and I can add the following comments:

I think that scientists have contributed little in this matter and their intervention has often disturbed efficient traditional methods practised by rural families. In fact the farming system is dynamic. There are considerable variations in the farming systems in developing countries and they often change in response to exogenous factors such as drought, economic policy reforms, patterns of demand on market, etc. For example, in many Sub-Sahara African zones, farmers have adapted their farming system for survival and adopted strategies which minimize risk in an uncertain natural and economic environment. Population growth and shortage of grazing lands are the main factors which sharply accelerate the process of integrating livestock into crop production systems and crop residues are becoming increasingly valuable as animal feed. Consequently, I have difficulty seeing how, when cultivable land becomes scarce in relation to population as occurs in South-east Asia and many African countries, integrated farming systems with major fodder crop components would be developed. Understanding the ways in which poor farmers overcome production constraints and develop farming system is fundamental to the analysis of the systems before parachuting in with « top-down » schemes.

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From Floyd Neckles <fanec@eclacps.undp.org>

Comments on the introductory paper

I am in the English-speaking Commonwealth Caribbean which consists of two bigger mainland nations, Belize and Guyana, and a chain of much smaller island-states.

The general background is agreeable. There should be emphasis on the "whole ration" and also what is expected from the particular animal or

group of animals. The benefit to be derived from the animal product on its disposal is important as agriculture in this part of the world is part of a very "monetised" economy. Level of performances must be suitably high with returns to the farmer that are compatible stimulating continued production. This does not mean that all units or aspects of a farm should be aimed at producing for sale. It is found that home consumption of products of the farm and also sale on informal markets contribute to either savings or to cash income. Integrated farming is being encouraged even where "monoculture" livestock or crop farms have been established and are operating.

I agree with Rodriguez in that there has been what I loosely call agricultural "mis-education" in training at the university level. This refers especially to systems of production and the use of farm and other resources. Often the technological solutions promoted for increasing production may be high cost and alien to existing agricultural practices and local circumstances. This is not to say that the basic principles learnt are not relevant but rather technical solutions offered should seek to be relevant to the particular context. Sometimes there has been dismissal of existing, traditional activity without attempting to grasp its relevance and basis.

Integration vs Specialisation:

In a sense we are fortunate that with small land area of the islands even the agriculture with its emphasis on export crops utilised some of the small-holder systems:

- (a) the tree cultivations were mixed with the possible exception of sugarcane (even here the small farmer tended to interplant other crops and in some industries estates reserved land for root crops, etc.);
- (b) animals were used for transport, power, manure and their meat and milk. They were reared in pens or zero-grazed, staked between the trees.

This changed with the attempt at modernisation in the 1960's and after. Then tractors replaced livestock for power, inorganic replaced organic fertiliser and livestock and crops were separated with special projects developed to increase livestock output by modernising production systems using improved grasses, imported animals and feeds,

etc. Many small farmers own/contract tractors for work and organic manure is used mainly in vegetables. They are returning to the traditional systems with integrated activity and use of local feeds.

There is a consideration I want to raise. In the early 1980's, we, at the Sugarcane Feeds Centre, felt that imported protein supplements should be replaced by local sources. It was felt the feed sources should be as far as possible from within the nation and should come from diversified national agricultural production. By the end of the decade it was recognised that local by-product feeds were being excessively priced, even in instances where no real shortage existed. The approach then had to be modified to encourage producers to utilise their resources, especially land, to produce as much of their needs themselves while reducing dependence on external sources to the minimum practicable or to the optimum level. This ought maybe to have been the emphasis from the start! but agricultural systems and production is in any event "evolutionary!"

System Definition:

The system definition based on agro-ecological zones is obviously applicable to the larger land masses. It is, however, also applicable to the small island situation. While the general climatic conditions in the geographic region are similar, there are significant variations in the rainfall between islands (influenced by latitude?) and between areas within the islands mainly influenced by topography. Along with the soil origin, history of cultivation (often historically damaged, eroded, etc. from previous plantation exploitation), water retention capacity, etc., there are differences in the agricultural possibilities - crops cultivated, system of production, etc. and related by-products and the animal rearing activity.

This influences how natural or introduced forages are used. In fact, in attempting to train and work in production systems in the region, the approach taken has been to encourage thought on the ecology, the resulting crop farm production and how animals may be better integrated considering social, cultural, historic and economic matters.

I will attempt to capture and explain more fully in a short presentation

on feeding resources in integrated systems in small island states in the course of preparation for this conference.

Floyd Neckles, Director, Sugarcane FeedsCentre Trinidad and Tobago

From Miltos Hadjipanayiotou <miltos@arinet.ari.gov.cy>

Comment on the introductory paper

It is stated in the introductory paper that animals have access to heterogenous materials (forages, fodders, trees etc), and that their nutritional value is affected by many factors (plant age, season, location etc).

Are the farmers aware of the above mentioned factors? Do they apply any control usage of them for maintaining the existing feed resources? Are the existing resources used in a way to obtain the maximum output of nutrients (quantitatively, qualitatively) and at the appropriate stage of production?

Finally, in case of absence of such knowledge, I am wondering whether it might be worthwhile considering the fact of producing/collecting such information locally, and thus contributing towards better and greater use of resources.

From: S. Bellon (INRA France) bellon@avignon.inra.fr

Comments on Hadjipanayiotou's comments on introductory paper

Hadjipanayiotou asked:

“Are the existing resources used in a way to obtain the maximum output of nutrients (quantitatively, qualitatively) and at the appropriate stage of production?”

For instance, one could address what "resources" actually are and why a "maximum" output should be expected?

This issue is obviously related to sustainability...

From: Jean S. ZOUNDI <zoundi@burkina.coraf.bf>

Hadjipanayoitou did a very pertinent analysis on the introductory paper. The question is important because in most cases the producers do not clearly feel the output of the digestion in terms of nutrients. What is important for them is the increase of liveweight and the body condition of their animals. They often perceive the feed quality only through the level of intake: they will recognize a poor quality feed for its poor intake and they will often use products as salt to increase the intake.

Despite the difficulty of appreciating fodders quality and the need to combine them adequately to offer the maximum of nutrients to the animal, it is still very important to take into account all the parameters when setting up the feeding systems. The producers' understanding is related to their level of instruction and training. Experience shows that in many places, the acceptance of innovations will be mainly dependant on these factors.

From Dr Thomas Acamovic <t.acamovic@ab.sac.ac.uk>

Comments on feed analyses

In terms of analyses of tropical feeds: I don't think that we know what the 'appropriate' analyses are for tropical feeds. I feel that components of feeds and other attributes that are not currently measured require attention (eg the composition of the polysaccharides, phenols, etc). These are very complex moieties and their effects may vary between plants although the types of compounds concerned may be crudely classified into what appears to be simple compounds eg. fibre, NSPs, tannins etc. Thus on the contrary to Rodriguez I feel that more, and more discriminative methods may be required (not sure what, mind you) to adequately characterise tropical feeds but techniques such as NIR yield a lot of information but requires adequate interpretation. NIR is however practically very simple to use, dry and grind the sample and scan it. The equipment and interpretation is however complex.

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Scotland, UK. Phone: (44)1224 480480 FAX: (44)1224 276717*

From E. R. Orskov <ero@rri.sari.ac.uk>

Comments on analysis of feed

Lylian's comments on feed evaluation are very pertinent. What is the most appropriate analysis? So much of chemical analysis have been done in order to fill tables in publications with little regard for whom the data is to benefit. In almost all cases robust biological tests are the most valuable, e.g. *in sacco* and *in vitro* gas production. Yet they do not always give the information required. There are exceptions. Sometimes palatability is a problem which cannot always be predicted by any known analysis: *Trichanthera gigantea* is loved by pigs but goats don't like it, based on experience by Dr. Preston's group in Vietnam. However we must work on finding robust evaluation methods. Crop residues are generally well evaluated by the above methods and much progress such as development of upgrading methods would not have been possible without use of rapid evaluation methods. Evaluation methods are needed for farmers to estimate exchange rate value for feeds and for planners of livestock production to match the potential of the prevalent feed resource base to the type of animal production. I agree that static western evaluation methods are of little value to farmers and planners when mainly roughages are fed.

I would finally like to add some comments on products from animals. We are educated to think specialistic, using parameters such as feed conversion etc. with scant regard for the resource value of the excreta. For pigs in Europe this has had the consequence that in many instances the manure is poisonous for sheep, fish and soil due to the high copper content because copper for pigs is a so-called growth promoter.

We must learn to see livestock in their holistic interaction with plant and soil because at least 90% of our clients are not specialistic livestock keepers. As pointed out by Dr. Kayouli, there are a multitude of products often not recognized.

The greatest products of grazing cattle under coconut trees in Sri Lanka at a high stocking rate was not animal gains or milk but coconut yield, due to greater biomass turnover and high water holding capacity of the soil. Supplementing the cattle gave responses both in increasing coconut yield, animal reproduction and milk and in soil fertility. There

are many such examples.

Poultry is kept by Kikuyu farmers in Kenya not only to produce eggs and meat but to produce excreta which is the supplement for the cattle consuming maize stover. Input to the farm is not artificial fertilizer but food. The success of urea treatment of straw is much greater if it is used for several purposes, upgrading, feeding of rumen microbes to stimulate intake and to provide manure with a higher nitrogen content. We need to train research workers to look at resource use from its production to its mineralization. Pollution is caused by inefficient resource use and attention to labour efficiency. We do not need in the foreseeable future to increase biomass production for feeding the world but we can gain enormously by paying attention to biomass utilization. Many small farmers in Asia, as pointed out by Lylian, give examples on how this can be done and even in China and Vietnam many resources are under-utilized. Livestock can and should play an important role in this process, but we need to have plant breeders, soil scientists and socioeconomics to be on board to make it happen and in some areas we need people with expertise in aquaculture and biogas.

Attention to total biomass use and of course soil fertility using livestock, biogas, aquaculture etc. also create rural employment which is so important as it will otherwise be converted to urban poverty of which there are many examples already with consequence for social unrest, crime etc. Has anybody from Asia or elsewhere information on what can be produced from say 1 tonne of rice straw in terms of nutrients for animals, biogas, fish and fertilizer or similar situations with complete resource use.

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From Peter Uden <peter.uden@huv.slu.se>

Comments on the use of feed analysis

It has become fashionable to denounce the use of feed analysis as a research tool in tropical animal nutrition. I do not agree with this particular school of thought. Lack of funds may be a reason for a reduced emphasis in laboratory analysis but so far we have no other tool to make comparisons between trials and to relate the feed to the animal responses. If we know nothing about the feed other than its name and the quantity consumed, how on earth shall we be able to sort out cause and effect?

The plant-animal interactions are strongly influenced by the environment, the genotype of both the plant and the animal, the phenological state of the plant and the physiological status of the animal. Plant composition does control the nutritive value even though we do not fully understand the relationships yet.

All functional feeding systems in the world rely on the successful merger of plant nutritive value estimated by laboratory analysis and information about the animal. For a successful "merger", animal trials are required where response factors are estimated. This has cost and will cost money, but a lot of knowledge can easily be transferred to the tropics. Magical interactions only found in the tropics have been used as arguments for not being able to transfer nutrition knowledge from temperate to tropical countries. I personally think this is based more on ignorance than on insight.

Development of feeding systems in the tropics will have to follow a similar path as that in the industrialized world. There are no short cuts and no basic differences between either plants and animals in temperate and tropical regions. Diversity is just greater in the tropics and our knowledge less.

How should we decide on what to spend our money in a nutrition trial? On laboratory analysis or on animals? Besides the fact that no scientific journal would publish the results without a minimum of analytical data, we would never be able to make any predictions which could benefit others.

Every country needs a functional feed evaluation system. Let's slowly build up the capacity for laboratory analysis and don't fool anyone than

only nylon bags and in vivo trials are enough.

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From Mauricio Rosales <rosales@vax.ox.ac.uk>

Comments on Orskov's comments about *Trichanthera*

Dr Orskov commented on the fact that chemical analysis cannot always predict palatability and used the example of *Trichanthera gigantea* being readily consumed by pigs but not accepted by goats, according to Dr Preston's experience in Vietnam. Although it is a good example to illustrate his point, it may leave the impression on the participants that this is always the case. I have been involved in the research on *Trichanthera* since it was started by CIPAV back in 1987. The first trial was carried with two breeds of goats. A local and an alpine breed, recently imported from Europe, were offered *Trichanthera gigantea* as a supplement to a diet of sugar cane tops and king grass. There were no negative effects on the animals, *Trichanthera* was readily accepted and milk production increased over the control. Since then, the use of this plant species has been validated in different feeding trials with rabbits, guinea pigs, hens, chickens, pigs, African hair sheep and dairy cattle. It has also been tested, to a lesser extent, on equines and buffaloes. Results have been positive most of the time, however, certain special cases, like that highlighted by Dr Orskov, were identified. Several hypothesis were put forward to explain the few cases when low biological responses were found: deleterious factors and amino acid imbalances (in pigs especially). Screening of anti-nutritive factors, including phenols, alkaloids, saponins and steroids were carried out. Results showed only the presence of phenols with great capacity to react with protein (hydrolysable tannins). No condensed tannins were found (tests included a characterisation of phenolic peaks by means of a spectrophotometer). It was also found that *Trichanthera* has a good balance of amino acids. The general result was that there is a wide variation in the nutritive value of this species.

Phenolic compounds for example showed a huge variation from 0 to 50,000ppm. This highlighted the need to identify if this variation was genotypic (different provenances), phenotypic (due to management), or a combination of both factors.

Trichanthera gigantea was introduced to Vietnam in 1991 and as far as I know (if this has been the only importation) this plant material came from one plot in the Cauca Valley, and due to the fact that this species is mostly reproduced by stem cuttings, it may well come from a single parental tree (the percentage of germination of the seeds is from 0 to 2% compared to 95% for vegetative propagation of the stems). The fact is that they may be dealing with a provenance which may not be palatable for goats. This can be one of the factors explaining the lack of acceptance by this animal species in Vietnam. The animals' lack of adaptation and deleterious factors in *Trichanthera*, as a response to a different environment, may well be others (This species is apparently native to the Andean foothills in Colombia, but its natural distribution is along streams and in swampy areas from Costa Rica to northern South America).

This species has several advantages over other fodder trees. It has an altitudinal adaptation range wider than most fodder tree species (from 0 to 2,000 metres above sea level). It is well adapted to the humid tropics with an annual rainfall between 1,000 to 2,800 mm and it grows well in acid (pH 4.5) and low fertility but well drained soils.

It grows better under a canopy. This is a fact well known by farmers in Latin America, who for centuries have grown *Trichanthera* associated with banana, plantain and under the shade of other tree crops. It has evolved in rainforest conditions in a medium stratum. One of the mechanisms of adaptation to these conditions is to have large leaves to capture sun light. To give an idea, a mature leaf of *Trichanthera* can grow as big as A4 size paper (under controlled conditions it can have a slightly smaller area than A3 size paper). These characteristics make this species ideal for multi-strata systems. The size of the leaves also facilitates its harvest and may facilitate its consumption by pigs.

Trichanthera gigantea is not a legume and it responds almost linearly to nitrogen from urea (up to 240 kg N/ha per year; optimum level appears to be 160 kg/ha per year). This characteristic also made this

species valuable for multi-strata, integrated tree cropping systems and mixed stands, as it responds extremely well when planted in association with a legume tree species.

Analysis of its carbohydrate fraction revealed that this plant had the greatest amounts of water soluble carbohydrates, and of total and reducing sugars, when compared with other fodder trees and shrubs. It also showed a surprisingly high amount of starch and its neutral detergent fibre was found to be the lowest. The high amounts of non-structural and storage carbohydrates combined with the low amounts of structural carbohydrates may explain the good biological results found with monogastrics. Analysis of *Trichanthera* foliage has also revealed a very high amount of calcium much greater than any other fodder trees or shrubs used in comparison. This is explained by the fact that this is a species of the ACANTHACEAE family. As in other acanthaceous plants, *Trichanthera* has cystoliths - small mineral concretions appearing as minute short lines on the upper surface of the leaf blades, the upper portions of the stems, on the branches of the inflorescence and on the calyx. These mineral concretions are particularly rich in calcium. This explains the use that the campesinos in Colombia make of *Trichanthera gigantea* as a lactogenic drink for nursing mothers and may also explain the good biological results found with dairy cattle, goats and sheep.

Research on *Trichanthera gigantea* continues. Five genetically different provenances have been identified (Clara Rios, personal communication, 1996). Differences in agronomic characteristics and nutritive value of the provenances have been established (some data is yet to be analysed). CIPAV's research programme on *Trichanthera gigantea* addresses several objectives which are, among others:

- to identify provenances and the creation of a bank of diverse germplasm,
- to compile the indigenous knowledge of the multiple uses of this species among farmers,
- to study the propagation and agronomic characteristics of this species,
- to study its use in multi-strata systems, and
- to characterise the variation in nutritive value between and within provenances.

There is already information available in most of these areas. Although a good deal of information has been published in various numbers of "Livestock Research for Rural Development", this species has not yet been included in FAO's "Tropical Feeds" and despite being successfully introduced and adopted by farmers, it has not been formally introduced' to the scientific community. A brief introductory paper, not by any means complete, will be presented later in this conference to serve both purposes.

Mauricio Rosales

From Dr E R Orskov <ero@rri.sari.ac.uk>

Comments on Mauricio Rosales' comments on *Trichanthera*

Many thanks for this very comprehensive letter explaining so much about *Trichanthera*. I have to admit I know very little about the tree though I admit it is very impressive the way it performs in the shade. We, Dr Preston and I, had a MSc student feeding it to goat. It seems that we have a lot to learn and I thank you for putting it right. It was just surprising to us that the pigs liked it but goats did not. Maybe Dr Preston would like to comment on this as well.

Thank you again for such constructive comments made in response to a perhaps rather ignorant remark. The reward is that many of us have learned something.

Bob Orskov

From Carlos A. Sandoval-Castro <pagr-cs@wye.ac.uk>

Comments on Peter Uden's point

The point made by P. Uden is very clear and very often ignored, especially when working in the tropics. If we want to improve the production of food from tropical resources, we need to be able to predict the performance of the animal and to do so, we need to be able to construct either empirical or mechanistic models.

Although mechanistic model should be made in an ideal situation, empirical modelling may offer an insight to the various relationships and interactions arising when feeding "non conventional" feeds.

The lack of ability to predict performance in the tropics will be as clearly stated by P. Uden, lack of knowledge or understanding of the transaction occurring in the animal.

The laws of thermodynamic should remain the same in the tropics as in temperate countries. However, the coefficients for utilization of nutrients may have to be adjusted for particular breeds, environments and diets, and it is on these points that further research should be made.

Results from Australia already suggest that *B. indicus* cows may have a nutrient partitioning which could be different from that of *B. taurus*. However, I believe that so far no system to predict animal performance accounts for this.

Somebody from Australia may please add further to this point, i.e. Hunter, Mc. Sweeney, Magnon.

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**From Dennis Poppi <D.Poppi@mailbox.uq.oz.au>
Comments on the use of feed analysis**

I have enjoyed following the conference and found the various observations most interesting.

On the shade issue Max Shelton and Barry Norton have a lot of data which was published in the ACIAR publication.

However the issue that got me to write was to support Peter Uden for people to do some chemical analysis. Chemical analysis can be used badly but that is no excuse for not basically describing the resource we are using. I am all for animal testing and we must believe what the animal tells us but if we are to move forward we need some descriptors of feed. Chemical analysis is one but not the only one. I am against the massive lists of every chemical known describing a feedstuff but in my own work a simple OM, N, NDF and perhaps lipid with some diets tells me a lot

and what I might expect. I also like to have data on *in sacco* rates and most importantly intake and digestibility by the animal and/or preferably animal performance. I rate animal performance the highest priority but without some underling descriptors of the food the information is limited. I realise in some areas it is difficult to get chemical analysis done and in other areas it is done without regard for what purpose it is to be used but it is still important to have.

I have found the observations of people from different areas most interesting in this conference and it is what makes advances when someone notices things about an animal or a plant. I always found the story of Ray Jones and the discovery of the *Leucaena* bug fascinating because of his well known ability to observe and wonder why. I suppose you don't really need chemical analysis for that!! Still it is the stories from around the world in this conference which I have found fascinating.

Dennis Poppi, Dept Agriculture, University Of Queensland, Australia

From E. R. Orskov <ero@rri.sari.ac.uk>

Comments on feed evaluation

I would like to make some comments re Peter Uden's remarks. I fully agree that we must develop feed evaluation systems. They are needed as I have indicated before both for planners of livestock production and for farmers to have some exchange rate of feeds and in general, Western systems of feed evaluation are not very good since they do not predict intake which is crucial when we are dealing with roughage based diets.

What we have to discuss is what are the priority measurements? Dr Uden thinks we are fooled if we think of *in vivo* and *in sacco* only.

We can probably all agree that we need the lab to obtain dry matter organic matter and N which must be combined with biological measurements obtained *in vivo* or some forms of *in vitro* measurements including nylon bags. After we have done that, we need to be more critical as to the cost effectiveness.

Sometimes there is no constant electricity in the lab so even some *in vitro* measurements are not good. What priority measurements would Dr

Uden suggest which would benefit the user. Surely not ADF: in a recent paper given by Dr Van Soest at the EAAP meeting in Norway he brilliantly illustrated the futility of those measurements as it has different meaning when day length is increasing and when day length is decreasing. We need to divide the feed into soluble and insoluble fractions. This could be done with the nylon bags or other simple methods.

If we suspect antinutritive factors, we need to look for that but they are only present in some feeds so we do not need to look for that in all feeds.

If we determined lignin routinely, can that help in addition to measurements already discussed? Lignin in leaves is not the same as lignin in stems. Lignin in legumes is not the same as lignin in monocots.

If we are to be paid by our clients the farmers, which must be the test, for routine analysis what analyses in addition to the ones mentioned could he afford to pay for?

We certainly need to generate more knowledge on this but with the present knowledge, there are many laboratory analyses routinely done which have no value whatsoever, but let us discuss priorities.

Dr E R Orskov

From Tony Goodchild <t.goodchild@cnet.com>

Comments on feed analysis

I'm glad that the "Shut the Feed Analytical Laboratories" topic is getting an airing again.

I think we all accept that all tropical feeds vary in nutritive characteristics from batch to batch, according to growing conditions, harvesting, processing, storage, . . . They even vary according to the variety of the source crop, and (as Peter Uden rightly says) according animal genotype and physiology. Probably every farmer in the world who feeds livestock knows and cares about this. Carlos Sandoval-Castro has already commented on the need to model the farmers' animals. Farmers also have to use the batch of feed that's available: they can't swap it for "average" sorghum stover or "average" peanut haulms or "average"

cottonseed cake . . . even if they could find it ! And surely our job is to produce advice for as many farmers as possible, not just advice for the rare farmer who actually HAS "average" feeds.

Therefore rapid reliable methods for predicting nutritive value are needed. (If one needs to do a full feeding trial* for each and every farmer, farmers would be better off doing the trials themselves, and we would be better off training ourselves for some other career such as anthropology!). [O.K. there's the very excellent nylon bag technique--but in our experience it's nearly as expensive as an animal trial; isn't that true, Dr Orskov?]

Let's accept that some--maybe most--conventional laboratory tests were inappropriate for tropical conditions. Surely that is NOT a reason for stopping laboratory testing. On the contrary, it means there is MORE work for labs to do. One of their jobs will be to decide which of the dozens of tests available are most appropriate for predicting the production of tropical livestock fed tropical feeds. Having identified these tests, the labs would then, as Peter Uden says, need to calibrate them using tropical livestock fed diverse samples of tropical feeds.

And in any case, a large proportion of conventional laboratory tests have been found inappropriate for temperate conditions, too. How many feed evaluation laboratories are being closed in developed countries?

In future we might see laboratory tests for nutritive value come down in price (making it easier to test batches of feed from villages or farms), and have a greater flexibility for calibration (making interpretation more appropriate to local needs). Already, NIRS (Near Infrared Reflectance Spectroscopy) is showing signs of moving in that direction . . . As you probably know, one scan with a modern NIRS instrument generates about 700 data points, from which dozens of chemical or animal-performance measurements can be predicted, PROVIDED THAT (laboratory or animal-house) CALIBRATION HAS BEEN DONE.

Apparently no-one has yet mentioned NIRS in the conference discussion. Would anyone hazard a guess as to when a respectable NIRS instrument will be as cheap and as portable as a laptop PC? I'd say it will be here in the time it will take for us to achieve our next food production revolution!

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From Chedly KAYOULI <101763.2164@compuserve.com>

Comments on feed analysis

I have read with interest Peter Uden's comments on the use of feed analyses. Although this discussion has little relationship with the main subject of the conference, I have some remarks to present:

1. No researcher ignores the importance of the use of feed analysis as a research tool in the tropics. Most tropical researchers have received their high-scholastic education in temperate countries including myself and we made a mistake when coming back and transferred nutrition knowledge from North to South without taking into account the reality in developing countries: How many feed laboratory analyses exist in those countries! (many) and how many are working! (only few), the lack of funds is not the major factor but the maintenance, the repair of equipment and the lack of qualified persons are often limiting factors without forgetting the quality of the water and electricity as raised by Dr Orskov. In addition, considerable feed analyses have been undertaken and are now available, but those purely chemical methods have not proved to be sufficiently accurate for the practical prediction of tropical feed value.

2. I believe that the functional evaluation system in the tropics should not be based on traditional laboratory analysis; when working on poor quality feeding resources and local breeds some simple feed evaluation research can bring better information. I share the same opinion with Dr Orskov, not through solidarity but from my own modest experience in Tunisia, where I have obtained better results with methods using living micro-organisms than with traditional laboratory analysis: The nylon bag technique provides a useful means of evaluating feed digestion; recently the use of the gaz production method could be considered of good potential as providing precise information on nutritive value of forages and even of tannins-rich feeds as browse species. The gas production technique is a fast, simple and inexpensive method to obtain reliable

information and it is more complete on the total degradation of feedstuffs (predicting digestibility), on the kinetics of degradation (predicting intake) and also (for people equipped with gaz chromatograph) giving information on production of volatile fatty acids and gaz (predicting metabolizable energy).

Kayouli Chedly, Institut Agronomique National Tunis, Tunisie

From: Andrew Speedy <speedy@vax.ox.ac.uk>

Comments on the feed evaluation/animal trials debate

It was the hope of the organizers of this conference that the subject would be feed resources within integrated farming systems. Nevertheless, Peter Uden has raised the question of feed evaluation which was the main subject of the last conference. The distinction is important.

We are confusing basic research which aims to understand the biochemical and physiological processes of the animal and systems research which seeks to answer questions about animal performance within environmental (farming) systems.

Of course there is a case for basic research using *in vivo*, *in sacco*, *in vitro* and even more fundamental laboratory techniques in order to understand the processes. And there is no reason why this should not be done by scientists in developing countries. Indeed, with many forages (tree leaves etc.) there is a very good case for doing this research on site because of serious questions about working with dried and processed samples when studying antinutritional factors. It is the complex questions which relate to tropical forages that require such laboratory study. But the case for routine analysis of concentrate feeds, protein supplements and especially straw and silages is much more questionable, certainly if they are done in the belief that they can be used in isolation to predict animal performance. The relationship between chemical components and energy value of straws for example has an r-squared value of about 0.3 and that for silages about 0.4. In other words, they are useless for prediction, even in developed countries.

Using such data in whole animal and systems research must consider

the issues of nonadditivity of nutrients, problems of sampling (given geographical, climatic, seasonal, soil, management and other factors), animal intake and animal selection, as was stressed in our introductory paper.

What is more important is that the whole area of systems research in the field environment is another and perhaps more important area of research which has been less effectively addressed in the past. Good on-farm research seeks to answer real questions about performance within systems and there is a need to consider the methodology and examine the data which is coming forward. I commend to participants the paper by Dr Janet Riley, statistician from Rothamsted, given at the workshop in Tuna Denmark in 1995 (available on the Web: <http://ifs.plants.ox.ac.uk/tune/riley.pdf>).

By all means let the laboratory scientists discuss the fundamental aspects of animal physiology but the purpose of this conference is to consider the equally valid area of systems research and the role of management and environmental factors.

As for what direction to place funds for research, I would advocate more use of limited funds for on-farm systems research which has been neglected in the past. The scientific value in answering the questions which pertain to farmers' needs and development are equally if not more valid.

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From Marco Esnaola <mesnaola%eapdz@sdnhon.org.hn>

Comments on feed analysis

I feel that this subject not only deserves more attention but I also think that Seminars or Practical Courses should be organized in different parts of the world. This alternative lab feed analysis such as in sacco digestibility, ammonia level in rumen, tannins and others should be taught by experienced instructors to lab technicians that have been trained

mostly in the classical Proximal Analysis Methods. I am telling you this because we have recently experienced great practical difficulties in getting rumen liquor samples from buffaloes in order to analysis ammonia levels. To my knowledge besides Dr. Preston's recent FAO book, not much has been written on this subject.

*Marco Esnaola, Escuela Agrícola Panamericana, El Zamoran
Honduras*

From Dr Thomas Acamovic <t.acamovic@ab.sac.ac.uk>

Comments on feed analysis

1. Interested in the comments of Uden, Poppi Sandoval Castro & Orskov. I agree with some of the points made by all but the comments seem to me not to be mutually exclusive.
2. It is obvious that chemical analyses is important, if not essential, for the assessment of feedstuffs for animals. At the risk of repetition, the important question is which chemical analyses are the most important? This may differ for different plants in different parts of the world and also for the different animals that will consume the plants.
3. It seems to me that we should try and cut corners if appropriate. We should use the knowledge of temperate and other systems but be aware of the differences and potential pitfalls. e.g. determination of 'protein' may be useful as is the determination of 'fibre' but what does that mean when the different types of protein and carbohydrate between plants will vary considerably as will their susceptibility to enzymatic and bacterial degradation. These factors, along with the various antinutrients, will strongly influence the nature of the feed, especially for monogastrics. Thus it could be argued that lots of CP determinations are wasteful of resources if it is their utilisation characteristics that are important.
4. It may be that nylon bags give reasonable results in some cases but not in others. Similarly for chemical analyses. I'm not sure that simplistic methods are appropriate, especially if the underlying mechanisms, are not known. Jones may have observed differences and asked why (probably as a lot of farmers around the world do) but he still needed the analyses

to sort out the problem and in that particular case 'simple' analyses were not sufficient.

I think the 'observation and why' is the key to avoid unnecessary laboratory and animal work where an integrated and flexible approach is used to assess feedstuffs and predict accurately (in most cases) animal performance.

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Van Soest's Abstracts: Further information related to the debate on feed analysis

For information, you will find hereafter the Abstract of a Paper presented at EAAP - 47th Annual Meeting, Lillehammer 1996, and mentioned by E.R. Orskov on 14 October in his comments on feed analysis.

Rene Sansoucy and Christophe Dalibard, Co-moderators

A Critique on the Problems of Predicting Feed Quality

P.J. Van Soest, 324 Morrison Hall, Cornell University, Ithaca, NY 14853, USA. (Email: tbk1@cornell.edu)

Estimation of feed quality usually involves the calibration of some laboratory-based measurement against in vivo values. Common measurements include fiber fractions, enzymatic digestion, protein and near infrared (NIR). Laboratory-based measurements are usually correlated empirically with digestibility, with the result that true scientific basis is not sought for the sake of practicality. Components like cell wall, ADF, lignin and NIR associations are environmentally affected so that calibrations with nutritive values vary depending upon source of samples. Mechanistic approaches have been put forward in the ruminant field and need more application. These approaches involve lignin ratio to cell wall, rate of fermentation, gut retention time and metabolic losses. These components can potentially account for differences among animal

species. The lignin ration to cell wall can also account for much of the environmental variability that occurs in fibrous feeds. The physicochemical restriction upon degradability and availability of energy and protein lie at a macromolecular size above that assayed by most analytical procedures. Thus current chemical methods are less satisfactory than biologically based ones, such as rumen fluid or enzymes that will reflect unmeasured physical and chemical limitations.

From: Frands Dolberg <frands@citechco.net>

Comments on Andrew Speedy's comments on the feed evaluation/animal trials debate

As an addition to Andrew Speedy's comment I may add that by getting scientists involved in on-farm research, I feel options have become many more than we used to think of before. That is important.

What is perhaps even more important is that it has put many of us on the learning curve as we see and discover things "out there" we did not see before.

Finally, being "out there" has raised important questions of priority, i.e. where is money and time best spent and we have seen that earlier methodologies were not always appropriate as we see from the discussion on feed evaluation.

However, I have just attended a CTA-sponsored workshop in Hohenheim about biometry in agricultural research.

More than 40 participants expressed concern about the present (mis) use of biometry in research in developing countries and they were hitting hard at people like us participating in this conference, not to drive us back to the experiment stations or laboratories, but to have us do a better job "on-farm".

I mention this as one more example of how "getting out there" has widened the world and left many established procedures challenged and in a flux, which I however, take to be fruitful and to be welcomed.

Frands Dolberg

From: Rios Arjona Guillermo <rarjona@tunku.uady.mx>

Comments on feed evaluation

I have been following this conference which gives very good material with reference to *Livestock Feed Resources Within Integrated Farming Systems*. However, in the first paper you call the attention on *Feed Evaluation*, a subject that I believed was discussed in the first electronic conference (I missed it). After this first paper, I started to see some comments about this subject. So, are we missing something. I would like to give some of my impressions about the same subject.

I believe that chemical analyses and animal experiments are still essential to make the link between what is real and the researcher ideas, with reference to animal production. As far as I know, chemical analyses were part of a whole to develop the present feeding systems in developed countries. So, why is it put in judgement? Are we going to deny the present feeding systems and the animal production output they produce?

In most tropical countries (non developed), improved animal feeding systems have not existed for hundreds of years, but only traditional practices were found. Their low outputs were adequate. They are still surviving. However, to know now if they are or not efficient, could be the key to promote them. Improved feeding systems are necessary in tropical areas in order to help the farmers to optimize the feed resources for increasing animal production levels and meeting the goal, in the context of a local or national market rather than an international one.

To develop improved feeding systems will be necessary to plan strategies and targets. At this point, analytical analyses will be very important. But actually, who knows which analyses are necessary and important to properly define the nutritive value of an ingredient or of a diet in the tropics? Which levels of animal production could be expected? Who knows which analytical analyses are important to describe a tropical feed? Presently, tables describing nutritive value of tropical feeds are not giving enough information (if any) on the anti nutritional compounds, and also, are not describing the relation of these compounds with nutrient availability, tested in animal feeding research.

The other problem is when people from developing countries did their postgraduate studies in overseas countries. Most of the time, they learned

one or two analytical techniques. So, when they are back to their country, they try to use them, without questioning if they are adequate to our own feeds, or if others are necessary. These techniques are generally the most up-to-date ones. Sometimes, the people teaching in these postgraduate studies are the developers of such techniques. So they are keen to spread their use everywhere but they do often not question their relevance in other parts of the world. More care need to be taken on that.

Indeed, I believe that less data exist on chemical analyses and nutritive value of less conventional feeds and forages, especially those found in the tropics. Because, in the past, nobody was interested. Also, few interest was put in the understanding of animal production in the tropics.

It is necessary to know for a feeding system the following:

1. For an input fed, how much output is produced with which efficiency and profit?
2. How much of the input is returned to the ecosystem and how does the ecosystem recycle (efficiency) it to produce again?

Therefore, chemical analyses are needed to understand the animal production in the tropics.

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From: Wolfgang Bayer <WB.WATERS@LINK-GOE.de>

Comments on forage quality

The forage calendars (I use "rules of thumb" in "guestimating" forage quality - I found some of the comments made re chemical analyses very interesting, but was amazed, that nobody raised the question of sampling - if animals graze or if they can select, sampling becomes a crucial issue. What use is the best method, if plants or plant parts are analysed which animals do not consume?) and the aims of animal husbandry give usually plenty of food for thoughts with respect to forage and feed management and animal husbandry.

One important aspect, I miss thus far, is the question of "optimizing".

The "rough and tough" economics give some guidance of what is possible under the present circumstances. For me it proved very useful, to make a difference between "supply driven" and "demand driven" systems.

Supply driven systems are systems where prices are such that high external inputs do not pay. This means that farmers or herders have to make the best out of existing feeds and forages (e.g. by letting animals select).

Demand driven systems can be found in Europe or north America and these are systems where a production target is set (e.g. a growth-rate of pig of say 600 g/day or for a dairy cow 7000 kg of milk per lactation) the needs of the animals are calculated, a ration is put together, deficits found, necessary inputs to alleviate these deficits defined, bought, included into the rations. Supply driven or demand driven systems rarely do occur in "pure" forms, these are rather end points of a continuum, but smallholders and pastoralists I know, are much closer to the supply driven end than to the demand driven one. The demand driven end is usually taught at university, and forage chemistry was designed to serve that end. I think that a large part of the confusion comes from applying such chemistry to predominantly "supply driven" situations.

There has been relatively little work on "supply" driven systems. Personally I found Gerrit Zemmeling's work (Wageningen University) very stimulating and useful in this respect.

Wolfgang Bayer, Smallholders and pastoralists, Ann Waters-Baye Rohnsweg 56, D-37085 Goettingen, Germany Tel: +49-551-485751 Fax: +49-551-47948

From R. Sansoucy and C. Dalibard Feed Analysis and Evaluation

A very interesting and stimulating discussion has been started on Feed Analysis and Evaluation. Up to now we have received more than 15 comments from different participants on this topic.

It is certainly not our intention to stop discussions of interest to participants. However, we would like to point out that :

1. Feed Analysis and Evaluation was the subject of the first paper of the First FAO Electronic Conference on Tropical Feeds last year and that it was abundantly discussed on this occasion.
2. As announced in the Invitation Letter, this Second FAO Electronic Conference is more concentrated on *Livestock Feed Resources Within Integrated Farming Systems* with emphasis on production systems.

In fact, we consider that the subject deserves more in-depth "analysis". Therefore, if many of the participants so wish, we could envisage opening a FORUM to pursue discussion on this subject, after the end of this conference, starting next January. All participants would be informed and would be invited to contribute.

From now on, all new comments on the subject will be kept back as contributions to this new Forum in January.

We hope you will find this proposal agreeable.

Rene Sansoucy and Christophe Dalibard, Moderators

**From: Dr Abd Rahman b Md Salleh <rahman@jph.gov.my>
Comments on tropical agriculture: where is it going?**

Andrew Speedy's comments on the feed evaluation/animal trials debate appears to be an attempt to bring the discussion back to the central theme of the conference:

"It was the hope of the organizers of this conference that the subject would be feed resources within integrated farming systems.../...What is more important is that the whole area of systems research in the field environment is another and perhaps more important area of research which has been less effectively addressed in the past"

In response to this comment above, I would like to raise an even more basic issue: TROPICAL AGRICULTURE - WHERE IS IT GOING?

I have been following this electronic conference with some interest from the time it started and have noted that the main themes discussed have been on supporting and improving the activities of smallholders and based on maintaining indigenous breeds. I wonder if the use of so much resources from within the tropical countries and through bilateral and

multilateral technical assistance programmes for such activities is in itself a sustainable undertaking and in the best interest of the under developed countries.

Coming from an underdeveloped country in transition the following issues are worth considering:

i) Smallholders are generally prisoners of the system suffering from poverty and waiting to escape as soon as the opportunity presents itself. They will accept assistance and subsidies but their underlying need is to better themselves and especially their children by whatever means possible. In Malaysia's case that improvement came mostly through industrialisation. Employment (jobs) appears to be the best method of poverty eradication.

ii) The smallholder agricultural activities in most countries in the tropics suffer from a high labour to other resources ratio especially land and results in low output per unit man-day that perpetuates their subsistence economic level of existence.

iii) The smallholder system has actually been optimised over the years to give the best there is in an integrated system within the overall constraints of the system. Intervention usually involves external resources that have to be handled by additional manual labour but results in marginal output/income increases. For example estimates of grass cut and carried manually to feed livestock is perceived to be heavier and heavier over time compared to volume if it is done day in day out by the farmer. The dairy cow of better genetic potential provided to farmers thus suffers from inadequate nutrition and becomes an additional burden to the system. Such additional manual labour is generally not sustainable as it is often not related to a very significant increase in income.

iv) Is it realistic expectation that agricultural production particularly food production in the tropical zone should continue to be carried out by smallholders to feed the cities where demand rises in direct proportions to economic growth led by the industrial sector?

Is it not an irony therefore that the part of the globe that receives the most solar energy and rain water becomes increasingly dependent on the temperate zone for its food supply? It is obvious that the capacity for plants to grow rapidly in the warm temperature environment has not been

studied and exploited to its most optimum capacity.

What is needed is that more of the research and development resources available be directed to adapting known agriculture technologies to suit the inherent characteristics of the tropics and to create new methods which may be radically different from those practised in the temperate zone but have the same productive capacity. It is very well to go into profound discussions on the merits and otherwise of analysing the nutritive value of fodder resources and agriculture byproducts as well as the economics of tapping palm trees as an animal feed resources but the theme of this conference is appropriate integrated livestock rearing system in the tropics that is sustainable!

The belief that the smallholders will continue to be the main thrust area for the tropics to feed itself into the future is a romantic notion that should appropriately be dumped into the wastebasket of history.

From Manuel Sanchez <Manuel.Sanchez@fao.org>

Comments on "Where is Tropical Agriculture going?" (Dr. Rahman Salleh's comments)

It would be nice to get into the debate about what way to follow towards improving the living standards of people in tropical countries, considering that the most of the so called "developed" countries have very serious social problems at various levels (individual, family, society) that none of the so called "developing" countries would like to have (like unemployment, drug addition, obesity, etc, just to name a few).

Nevertheless, in this electronic conference we are discussing matters related to how to make better use of local resources to increase animal production within sustainable systems.

It is clear that the green revolution (including the industrialized monogastric production as part of it) has allowed significant increases in food production but with a huge negative impact on the environment and on biodiversity. We certainly urgently need alternative sustainable models. We can not say that intensive swine production, with imported feeds from the other side of the world and causing pollution of soil and water, despite the high productivity per sow, is a good example to follow.

Nor is dairy and beef production based on grass monoculture, that gradually destroys soil fertility and limits opportunities for bioersity, specially in those areas that previously had forests.

The greatest damage to tropical animal agriculture has been the imitation or adaptation of production systems from temperate (developed) countries. Soil and environmental conditions, as well as plant and (sometimes) animal resources are so different, that appropriate local systems are needed. For instance, the concept that ruminants, both large and small, have to be reared on grass in the tropics as it is done in temperate areas, is causing in many places irreversible negative effects on the ecology that could be in the near future an issue in environmental suits.

The only hope to develop sustainable livestock and agricultural production systems is with small holders, who can conserve the environment and biodiversity. Monoculture agriculture as practised by large owners or companies not only is causing damage to our planet but also to our societies in their sake of short and medium term profits, by exploiting labour (both local and imported, legally or illegally) and by preventing the highly valued rural development.

The keys for finding these sustainable systems are to be found in the traditional combined with our scientific knowledge. For example, some of forages belonging to the third generation, following grasses and legumes, composed of the highly nutritious broad-leave plants like *Morus*, *Hibiscus*, and *Malvaviscus*, which allow milk yields of 20,000 l/ha without concentrates, have been used by the Chinese farmers for hundred and maybe thousands of years.

It is clear that in most cases technologies from temperate areas are not going to improve the living standards of the people living in tropical countries in a sustainable manner, thus for our own sake and that of our descendants, lets keep looking for those systems and technologies that best fit our present needs without damaging the environment and without putting in danger future generations.

M. Sanchez, Animal Production Officer, AGA, FAO, Rome

From Robert Faust <drfist@ilhawaii.net>

Comments on sustainable farming systems

I thought I'd make a comment from my unique perspective as a tropical farmer and as a researcher in tropical polyculture and Hair sheep based agroforestry systems. I have been a researcher, farmer and consultant for 25 years. The issue on sustainability is well put, how many years does it take: 5, 25? I say it takes a thousand years to prove sustainability of an agricultural system. Here on the island of Hawaii, it was proven, and would be working today, if Capt. Cook never showed up. I presented a paper on the subject at the IFOAM conference in Copenhagen this summer and it will be on the IFOAM page of abstracts and published in the proceeding. In terms of sustainability, of course going broke, is not sustainable, so the first criteria is going to be can you survive financially. If you cannot make it financially how can you continue and how can you call it sustainable? It becomes kind of an academic exercise to talk about it, when very few academics have ever done it. In the real world of agriculture it is a struggle just to survive, let alone take a risk with your family life trying something new. I am all for all these good things, I have a full example of what can be done, but I am practically the only one with the knowledge, skill and resources to run it, there is quite a learning curve to successfully survive at tropical small farming. The real trick is to make it work for the small farmer, this is a policy issue, beyond the scope of science, if the problem was just information there would be no problem, there is sufficient information out there. The problem is usually money, and it is easy justifying "slash and burn agriculture" or till , spray and erode "modern: agriculture, when your family is hungry or those mortgage payment or tractor payment is due. The real question is how do you change the overall system to allow innovation. As you well know the applied part of agriculture is on the low end of the priorities on the part of academia. Maybe the applied science people with hands-on experience should start teaching in a formal setting, I am available.

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<http://www.wp.com/bioag/>*

From Dr. Collin Boyle <menzo@caribsurf.com>

Comments on Sustainable Livestock Production in the tropics

I want to agree with the comments made by Manuel Sanchez of FAO concerning the use of forages as feed for livestock.

I am from a small island state in the Caribbean (St. Vincent and the Grenadines). In recent times, our farmers have been hit by the harsh reality of the ever escalating prices of concentrate feeds for their livestock to a point where the profit margin is decreasing rapidly.

Feeding of ruminants in this country, has historically been based on improved grasses e.g. African Star, Pangola, Tanner, Elephant grass, etc., supplemented by concentrate feeds. During the rainy weather, the grass is abundant. In the dry period, which spreads over approximately six months, the grass if not irrigated is scarce. Farmers are therefore forced to utilize excessive concentrate feeds.

Generally, farmers utilize to a limited extent live fences of *Gliricidia* as supplementary feeding and interestingly, these trees are not affected by the dry weather.

Recently, with the assistance of FAO, we have been seriously exploring more sustainable methods of ruminant and pig production. Instead of using the *Gliricidia* as live fences only, we have embarked on a programme of cultivation of legumes and forage trees high in protein content on our livestock stations. We are also cultivating the traditional pastures with these trees, and supplementing the diet of the animals with multinutrient blocks produced locally. This hopefully will achieve the following:

- 1) Increase stocking rate of animals/acre because of the high output of biomass of these plants /acre when compared to grasses.
- 2) Provide cheap and ready source of high quality feeding materials all year round.
- 3) Reduce drastically the amount of concentrates used, thus reducing the cost of production.
- 4) Decrease soil erosion.
- 5) Enhance the environment (increased O₂ / CO₂ exchange).

Dr. Collin Boyle, Chief Veterinary Officer, St. Vincent and the Grenadines

From Robert H. Faust <drfist@ilhawaii.net>

Comments on Collin Boyle's comments on Sustainable Livestock Production in the tropics

In regards to Dr. Boyle's situation in St. Vincent, it sounds like a similar situation here in Kona Hawaii: same grasses, same 6 mts. dry season. I have been developing an agroforestry system using St. Croix (African) Hair Sheep, *Gliricidia*, *Sesbania sesban*, and *Desmodium* ground cover. The idea is to graze weeds and *Paspalum notatum* in coffee and fruit orchards, in alley cropping and shaded with N fixers. Areas are let untouched till the dry season, then they are turned into masses of *Desmodium*; the N fixing trees are limbed for feed. Works great, problem is I am in Hawaii, all the lamb meat come from New Zealand or the US mainland, frozen, and cheap: no market for my sheep.

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From E Fernandez-Baca <ferbaca@amauta.rcp.net.pe>

Comments on the conference

I have been following with interest the development of this FAO electronic conference on Livestock feed resources within integrated farming systems, as well as the comments of the participants representing such an enormous diversity of cultural, socioeconomic and ecological conditions. There seems to be a general consensus on the need to develop sustainable animal production technologies within integrated farming systems, for which purpose the proper utilization of local feed resources is one of the essential elements. The research results and individual experiences that are being communicated along this electronic conference show the progress achieved on this subject and are, with no doubt, valuable contributions to attain the goal of sustainable production. However, what is a matter of concern is the fact that in spite of the availability of such information the extent to which this is applied in the field, especially at the resource-poor small farmers' level, is very limited.

Therefore a great deal of additional effort is needed to ensure the proper dissemination of research results and the experiences of progressive farmers.

Furthermore, fundamental adjustments are needed in the curricula of most higher education agricultural schools and universities which are highly influenced by those of developed countries in temperate regions. Quite often professionals educated with such a model are more difficult to convince than farmers on the need to adopt approaches more in line with the local conditions. It would be highly desirable a more active involvement of professors and students of agricultural schools and universities in this type of research to contribute not only to the generation of new technologies but to its dissemination.

Saul Fernandez-Baca (former FAO Officer) Peru

From Carlos Lascano <C.LASCANO@CGNET.COM>

Comments on feeds within farming systems

I have been following with interest the electronic Conference on Feed Resources in Farming Systems. Papers presented and comments made by several participants have been useful, even though to my surprise the debate on chemical analysis of feeds continues. On the other hand, I feel that in some cases there has been inadequate consideration of the farming system in which feeds being described are or will be used, utility of the resource to farmers and their impact on natural resources. Thus, at this time, I would like to share with colleagues in the conference a new initiative led by CIAT on improved feeding systems for dual purpose cattle systems in marginal areas of Tropical America. The project known as TROPILECHE, operates under the CGIAR System Wide Program convened by ILRI.

A brief description (6 pages) of the Project "Improved legume-based feeding systems for smallholder dual-purpose cattle production in tropical Latin America" (TROPILECHE) can be obtained by sending a message to:

MAILSERV@MAILSERV.FAO.ORG

No subject required. The message should be simply:

SEND [TFCONF2]LASCANO.TXT

This project is currently underway in two benchmark sites: subhumid hillsides in Costa Rica (Esparza Region) and forest margin in Peru (Pucallpa region). I hope that this contribution illustrates a holistic approach to feed resources in the context of livestock production in pasture-based systems, common in LAC.

Any participant in the Conference that is interested in obtaining more information on TROPILECHE please contact me.

Carlos E. Lascano <c.lascano@cgnet.com> CIAT, Cali, Colombia

From Danilo Pezo Quevedo <dpezo@cariari.ucr.ac.cr>

Comments on introductory paper

In the introductory paper, the organizers of this electronic conference (Speedy, Dalibard and Sansoucy) stressed the opportunities for integrated production systems in terms of their potential contribution to food security, sustainable land use and improve the welfare of the rural poor. Usually these complex multi-component integrated systems are seen as related to small and perhaps medium size farms, whereas specialized systems to larger enterprises. I am convinced that to respond to the new agricultural policy elements of the 90's (e.g. market globalization, reduction or elimination of subsidies, sustainability) and to increase competitiveness in tropical animal production systems, regardless of farm size and type of livestock enterprise, some of the adjustments needed are diversification (integration with either crops, trees, or both) and rational management of the interactions among these components and with the natural resource base.

*Danilo A. Pezo, Consultant in Pastures and Ruminant Nutrition
Visiting Professor, University of Costa Rica*

From Frands Dolberg <frands@citechco.net>

Comments on Fernandez-Baca's and Bellon's comments

Concerning involvement of students in research in rural areas, I can refer to two papers. One describes experience from Bangladesh and is in vol 3.1: 1-10 of the journal *Livestock Research for Rural Development*, which can be www accessed on:

<http://ifs.plants.ox.ac.uk/lrrd/lrrd.htm>

The other on:

<http://ifs.plants.ox.ac.uk/tune/tune95.html>

is an experience from the Altiplano in Bolivia and that experience (more than 30 students) is described by Abel Rojas in the proceedings of a meeting in Denmark, but available on the address above on the Internet.

In both cases, the research involvement of several students over a number of years (5 and above) was associated with substantial production increases. Inland fresh water fish in the case of Bangladesh and milk in the Altiplano. It is really an unrealistic dream that we can assist resource poor farmers without a sound backing of knowledge.

Recently, I got across a comparable experience in Zambia, where a CIMMYT team in the mid-80 had supported on-farm research by students.

There is the ongoing programme spearheaded by Dr. T.R. Preston with students from several countries (a large number from Colombia and Vietnam), which clearly shows that provided the attitudes of teachers (critical factor as you point out) is in place, it is perfectly feasible to conduct research of relevance for small farmers.

However, not only teacher's and supervisor's attitudes are critical factors. Compartmentalisation in agencies and governments are as well. One department is meant to be only for development or extension while another only for research, which is not fruitful. It is often when we try to implement/do extension we identify problems and that is when we should be able to call in research instantly. As a minimum, development and extension projects should therefore contain budget lines for research.

Frands Dolberg

**From Reg Preston <thomas%preston%sarec%ifs.plants@ox.ac.uk>
Comments on Dr Abd Rahman's comments on tropical agriculture:
where is it going?**

Dr Abd Rahman is advising us to be realistic and accept the inevitable (according to his logic) that we will come to accept traffic congestion, air pollution and the social ills of too many people in too little space with nothing very much to do except watch "blockbuster" or "Dallas-type" programmes on TV to carry us away from the stark realities of the outcome of economic progress. Having lived in a country in Latin America whose social infrastructure has been effectively destroyed by the incurable drug-consuming habits of the "most economically developed" country in the world I and many like me are not ready to accept the "inevitable" pathway and consequences of "development".

Why should we produce food for the cities? Why not create conditions in the countryside that will provide the essentials of a better life (health, education, information are the main ingredients needed)? Because the cities are where the votes are and therefore politicians will ensure that they are favoured by government policies which effectively means that they are subsidized by the rest of the country. Is it romantic to think that the polluter (the cities) should pay? Is it romantic to voice opinions that perhaps not everyone is happy with consuming products of genetic engineering which by definition are not sustainable. BSE (mad cow disease) is a warning of the dangers inherent in the "high- tech" pathway; the reaction of the public showed clearly the lack of confidence in both "science" and "government".

Fossil fuel has driven the present model of economic development. Until the reserves begin to dry up (50 years?) the rich countries will continue their unsustainable life style. But then what? Nuclear energy for all? The optimists (in the rich countries that will supply the technology) will no doubt say yes. But will it create jobs - even fewer than the fossil fuel industry! Overall public opinion would seem to be against such a scenario.

So we are likely to have to rely once again on the sun's energy which means an important role for biomass as source of food and fuel and the tropics will have the comparative advantage. Dr Rahman rightly reminds

us that we have done little to capitalize on this comparative advantage (incidentally it is the agronomist who have shown the way in Malaysia with the tremendous success of the oil palm tree). But I think I am right in stating that the livestock scientists have shown much less initiative as the closest the livestock get to the oil palm is to be allowed to graze underneath it. The pig and poultry producers prefer to use "temperate crops" in the form of imported grains in spite of the fact that technologies have been developed for using the oil and the fruit of the oil palm tree for both pigs and poultry.

Poor farmers, by definition, practise sustainable agriculture (or they used to until the demand for "development" came along in the form of cattle ranchers and loggers). They have developed technologies that use minimum external inputs and maximum use of family labour (their major comparative advantage) and, frequently, use plants/trees of high productivity and efficiency of using solar energy (a free external input). So if we help "poor" farmers (poor financially but rich in skills and culture) then we are likely to be putting efforts into worthwhile ecosystems; and with our scientific skills perhaps we can find a way to harvest the sap from palm trees without having to climb them. And maybe a more careful study of indigenous breeds will help us to develop ways of using more efficiently the leaves from such highly productive protein-rich crops as water plants and multi-purpose trees. And if we help "poor" farmers to be less "poor" that is not a bad thing. And if at the same time, with our integrated approach to rural development, we develop cheap, renewable sources of fuel for cooking (biogas) and lighting (solar voltaic panels and gasifiers) and communication (computers, cellular phones) maybe when the "poor" farmers become less poor they will prefer to stay in the countryside working part-time on the farm and part time (with their electronic communication technology available at village level) in the "information" industry which we are told will be the dominant job provider in the next century.

Romanticism? Much of the technology exists; of the potential of tropical natural resources there can be no doubt. The constraint is our "Northern" training which plays squarely into the hands of the corporate industrial sector happy to use cheap labour in the form of displaced rural

dwellers and quite prepared to keep them dependent on their "Northern" technology instead of keeping them develop their own "tropical" systems.

This conference is precisely concerned with developing such "alternative" systems. But first we must believe in the "south" and in the resources of the "south" especially the tropical farmers, for their knowledge and experience will serve us much more than all the agricultural science imported from the "north".

So Dr Rahman, please stimulate your livestock scientists to stop looking down (at grass growing under the trees) and to project their sights upwards at the incredible resource known as the palm family. And to emulate with livestock what their agronomist colleagues have done in developing the cheapest source of edible oil on the world market.

Reg Preston, Vietnam

From Hermenegildo Losada Custardoy <hrlc@xanum.uam.mx>

Comments on T.R. Preston's comments on "death for the cities" by a group of Mexican researchers forwarded by Hermenegildo Losada Custardoy

We are a group of researchers, working in one of the largest and most polluted urban centres of the world, who are trying to understand and therefore to digest the concept of sustainability. We agree with most of the comments from T. R. Preston referring to rural sustainability and the rights of the poor population to have better standard of living, in particular in the developing countries that often have to support the developed ones. Where we disagree is that large urban centres have to disappear in order to implement sustainability. In this respect we have arrived at the conclusion that what really needs to disappear is the 'Western' model that most of the large population centres of Latin America have adopted as their prototype which clearly is 'against' nature, and therefore sustainability. We consider this 'Western' model is responsible for a misunderstanding of development which often associates concrete with a better standard of life. The result of this fatal misunderstanding is that most of the cities tend to create pollution as a

new export product. As a result of our research we have reached the conclusion that more appropriate is the use of the 'Eastern' model, in which nature is an integral part of the city. One question that arises from this proposal is how to reach development without poverty, which seems to be the main limitation of sustainability in the city. We believe that a model for sustainable living in the city is more likely to be developed from an understanding of this relationship with nature as demonstrated by the peri-urban farming systems of countries such as India, Africa and here in Mexico.

In our experience here in Mexico City a good deal of the traditional agriculture and livestock production has undergone a transformation from the conventional system towards a new sustainable proposal, meaning that the systems have found a new way to survive by adapting to their new urban conditions. For example, the use of rubbish in dairy stables represents a very important source of food for the production of milk; there is a wide use of swills to feed poultry and pigs; and we have also found an extensive use of manure in peri-urban agricultural production. This leads us to the conclusion that the role of the scientists is limited because the local producers are keen to find their own solution. We feel it is more appropriate to accept that these peri-urban systems are alive, and it is worth continuing research on these situations where we believe a sustainable proposal based on the experience of the peri-urban producer could be just one of the solutions for these large urban centres.

**From T.R. Preston <thomas%preston%sarc%ifs.plants@ox.ac.uk>
Comments on comments by a group of Mexican researchers**

An important point has been made and I stand corrected. I should have said the "Western" model of the city, because as he points out the "eastern" model is much more linked with nature. In fact, Bob Orskov and I when driving to the airport commented on the fact that there was no reason why all the roof tops should not have trees growing there and thus the city could become green and in the process act both as a sink for the CO₂ it produces but more importantly grow more of its own food.

Several of Losada's papers can be found in Livestock Research for Rural Development on WWW at <<http://ifs.plants.ox.ac.uk/lrrd/lrrd.htm>>

Dr. Thomas R. Preston, Vietnam

From Michael Allen, Auckland, New Zealand

<ml.allen@auckland.ac.nz>

Comments on Sustainable Technology

I have followed the various papers with a great deal of interest because it is apparent that many people in widely separated locations can use this technique to share and transfer relevant technology.

But there are some underlying assumptions in many of the comments that I believe should be addressed. If we are to achieve sustainability in food production it is essential that we are aware of other constraints produced by other demands. Reg Preston in his recent comment mentioned some of these and I could certainly expand on his views from the viewpoint of an engineer. Perhaps this is not the place.

Some of the constraints include the universal need for water and fuel for cooking. So, for example, when considering trees for forage, species which yield fuel-wood or useful timber for building may actually have a higher priority in rural life. Thus *Leucaena leucocephala* is widely recommended for incorporation in animal feed but it also has considerable value as a fuel wood and as a source of wood-ashes for making soap. This makes it especially valuable over and above the needs for animal nutrition.

In the second paper of this excellent conference, Rodriguez and Preston touched on the general need for rural fuel supplies. And while the durability and sustainability of biogas generators based upon plastic sheet may be questionable, the value of the resulting methane/CO₂ mix cannot. That "most troublesome weed" water hyacinth *Eichornia crassipes* is not, I believe, highly regarded as fodder. However it will yield a massive cubic metre of biogas for every kg of dry matter if introduced into the biogas reactor feed.

As has been remarked, dung is widely used as a fuel. Animal

nutritionists may argue with geneticists as to the best feed/breed for a draught animal in the tropics. And a great deal is now known about the effect of bypass protein on production rates. (I would expect their diet has been chemically analysed in many first-class laboratories to the limits of our present instrumentation). But I do not think anyone has considered the optimum feed/breed combination to produce adequate dung, milk and draft power for a typical Indian family. Please correct me if I am wrong.

I remember looking at the very small milk cows in the hill country of Java and wondering why they didn't use larger breeds. The answer, it turned out, had little to do with available feed or efficiency. It had to do with school fees! Selling the leg of a large cow to pay school fees was much more damaging than selling a small cow.

My point is that we must take an overview of what people require before we seek to optimise just a part of the overall process.

I put these views forward to the conference with some trepidation because I am only an engineer. However, we engineers have learned this particular lesson from bitter experience and I would seek to shorten the learning period of my fellow technologists.

I mentioned water as another constraint and I could digress on the technology and energy necessary to conserve and make efficient use of water in animal production. But I'll save that for another occasion.

I wonder if we have really given enough thought to how we extend the lessons of subsistence and survival farming to make a sustainable system of food production for the next 4,000,000,000 people expected shortly on our planet. (Bearing in mind that they will be largely an urban population). Again Rodriguez and Preston touched upon this in their excellent paper but, apart from Reg Preston's comments, I have not seen much discussion on the implications to animal husbandry. I suspect that the Preston solution to make the rural environment attractive to these 4×10^9 warm bodies would be counterproductive: I think that we have all seen what urban sprawl does to prime quality farm land!

As an engineer I am aware that my profession has played a key role in facilitating exponential human population growth. Historically the only constraints which have limited city size are the pollution problem (and resultant disease), the lack of fuel, the lack of water and the lack of food.

I rather doubt that the idyllic pastoral life of sustainable technology pictured by Reg is just around the corner. Certainly we must curb our lust for non-renewable energy. But we must also seriously address the problem of overstocking the human grazing fields.

All we technologists can do, it seems, is to buy time for the human species to make a few basic changes to its lifestyle. Perhaps we have become so used to this objective that we now no longer question it!

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From Frands Dolberg <frands@citechco.net>

Comments on Michael Allen's comments

I read Michael Allen's comments with much interest.

Two fast remarks. When in the early 80 we measured weights of cows in Bangladesh and related weight to size of holding, we found a very positive correlation. Small holdings, small cows; large holdings, large cows.

However it is these small cows that landless women to a very great extent have invested in through the now world known "Grameen" type of loans, now practised by many organisations (NGOs) in Bangladesh and other countries.

This relates to the population question, because in 1974 it was estimated 6.7 children were born per woman in Bangladesh. In 1995 this figure had dropped to 3.5 children. The reason is not literary, but rather the small loans now available to many landless and rural women, giving them a hope for the future and enhancing their status in their facilities and thereby - to a greater degree - enabling them to control fertility.

However, the point is livestock - and that is small livestock - has played a very significant role as an investment objective. In recent years the emphasis has shifted to rural poultry and we will hear more of that later in this conference.

Frands Dolberg <frands@po.ia.dk>

From Paschal Osuji <P.Osuji@cgnet.com>

Comments on Estimation of sustainability

On the issue of estimation of sustainability, my colleagues Ehui (S.Ehui@cgnet.com) and Jabbar (1996) have agreed that I share the abstract of their paper on "A Framework for evaluating the sustainability and economic viability of crop-livestock systems in sub-Saharan Africa". pp 14. The abstract is provided here:

Abstract

Livestock are an important component of farming systems in sub-Saharan Africa. They are raised mainly for meat, milk and skin and provide a flexible financial reserve in years of crop failure. They also play a critical role in the agricultural intensification process by providing draft power and manure for crop production. With increasing human population and economic changes, cultivated areas in many sub-Saharan African countries have expanded onto marginal lands and fallow periods are being shortened. As a result, large areas of land have been degraded and crop and animal yields have fallen. Improved crop-livestock production systems and technologies are currently being developed in response to the growing demand for food and the degradation of the natural resource base. These technologies must not only enhance food production, but they also need to maintain ecological stability and preserve the natural resource base, i.e. they must be sustainable. However, the notion of sustainability has been of limited operational use to policy makers and researchers attempting to evaluate new technologies and/or determine the effect of various policies and technologies. This paper discusses a methodology for measuring the sustainability and economic viability of crop-livestock systems. The approach is based on the concept of intertemporal and interspatial total factor productivity, paying particular attention to the valuation of natural resource stock and flows. The method is applied to a data set available at the International Livestock Centre for Africa (ILCA). Intertemporal and interspatial total factor productivity indices are computed for three farming systems in southwestern Nigeria. Results show that the sustainability and economic viability measures are sensitive to changes in the stock and flow of soil nutrients as well as material inputs and outputs. The advantage of this

approach is that intertemporal and interspatial total factor productivity measures are computed using only price and quantity data, thus eliminating the need for econometric estimation. Sincerely,

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From Dr Abd Rahman Salleh [rahman@jph.gov.my]
Comments About Sustainable Local Crop - Livestock Integration
Cattle Rearing in the Tropics - to make it sustainable

Since nature dictates that the solar energy in the tropics is absorbed and converted to trees - hence the tropical rainforest - cattle rearing must be subservient and complementary to tree crops which gives higher return/hectare and "preserves" the tropical rainforest effect to a greater extent. The shade effect is beneficial even to tropical breeds which are supposedly heat tolerant.

Uncontrolled grazing of cattle in palm oil plantations has been practised much earlier but it has led to overpopulation, overgrazing and social conflicts among land settlers. The more recent experience in this area in Malaysia seems to indicate that a more regulated grazing system is the best integration system for rearing cattle in the tropics that meets the sustainability test after nearly 10 years of observation.

The characteristic of cattle farming under oil palm that appear to be sustainable are as follows:

- (a) It must be run as a commercial undertaking and participation of the plantation resource owner is critical.
- (b) Grazing is controlled by easily movable electric fencing in 10 hectare plots together with a mobile shelter for the herdsman and watering facility for the herd.
- (c) Grazing rotation is integrated with the normal plantation schedule of harvesting, weeding and fertiliser application.
- (d) Herbicide use is limited to the non-edible forage species and weeding is carried out immediately after the herd has left the particular area to allow edible forage regrowth.
- (e) The herdsman is trained to balance resource available with herd size and to move the herd as forage availability run low.

(f) The project owner must be motivated to increase income/hectare of land instead of income/hectare commodity output.

(g) Small holder participation is conditional on the project being run on consolidated grazing resources with land owners being shareholders only and receive minimal government support.

To date 90,000 head of cattle are managed under this system out of a national cattle population of 680,000 [in Malaysia]. The majority of the cattle population are under threat from loss of grazing resources due to urbanisation. Fortunately it is accompanied by a drop in dependence on small scale farming as a source of income due to industrialisation. In fact the process of transformation is right along the lines of the National Agricultural Policy of commercialisation and optimisation of resource use with minimal subsidies.