Comments on Introductory Paper

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

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 sure that experimental (small-scale) models actually translate to the 'scaled-up' real world?

In addition, there is the issues 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 most 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 became 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 and 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, Trichanthera 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 m^2, 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.

Chedly Kayouli, Professor of Animal Sciences, Institut National Agronomique de Tunisie, 43 Avenue Charles Nicole, 10082 Tunis, TUNISIA

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 Feeds Centre Trinidad and Tobago

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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 acceptation 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.

Dr T Acamovic, AFT Dept, SAC, 581 King St., ABERDEEN, AB24 5UD 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.

Dr E R Orskov, Rowett Research Institute Bucksburn, Aberdeen AB21 9SB, UK ; Tel. +44 1224 71661; Fax +44 1224 716687 http://www.rri.sari.ac.uk/xbc/

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.

Dr Peter Uden, Department of Animal Nutrition & Management, Box 7024 750 07, Uppsala, Sweden, tel.: 46-(0)18-672058, Fax: 46-(0)18-672995 e-mail: peter.uden@huv.slu.se

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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.

Carlos Sandoval Castro fmvz-uady, apdo postal 4-116 itzimna Merida Yucatan, 97100, Mexico (bcasso@tunku.uady.mx)

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

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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@cgnet.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 of 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!

Tony Goodchild, International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria <t.goodchild@cgnet.com>

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.

Dr Andrew W. Speedy, Dept Plant Sciences, University of Oxford, S Parks Rd, OX1 3RB Tel: +44-1865-275111 Fax: +44-1865-275074 E-mail: speedy@vax.ox.ac.uk

From Marco Esnaola <mesnaola%eapdzo@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 Agricola Panamericana, El Zamorano Honduras

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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.

Tom Acamovic, AFT Dept, SAC, 581 King St., ABERDEEN, AB24 5UD; Scotland, UK. Phone: (44)1224 480480 FAX: (44)1224 276717 e-mail: t.acamovic@ab.sac.ac.uk

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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 ration 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.

Guillermo R[?]os Arjona, Facultad Medicina Veterinaria y Zootecnia Univ. A. de Yucatan 4-116, Itzimna Merida, Yucatan 97100 Mexico Phone (99) 46-03-33 fax (99) 46-03-32 e-mail rarjona@tunku.uady.mx

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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 Zemmelink's work (Wageningen University) very stimulating and useful in this respect.

Wolfgang Bayer, Smallholders and pastoralists, Ann Waters-Bayer 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 bioversity, 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 mortage 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.

Robert H. Faust Ph.D. Agroecologist Faust Bio-Agricultural Services, Inc. P.O. Box 800, Honaunau, Hawaii 96726 U.S.A. 808-328-2083 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 O_2 / CO_2 exchange).

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

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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 agroforesty 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.

Robert H. Faust Ph.D. Agroecologist Faust Bio-Agricultural Services, Inc. P.O. Box 800, Honaunau, Hawaii 96726 U.S.A. 808-328-2083 http://www.wp.com/bioag/

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

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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%sarec%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 <htp://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 $4x10^9$ 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!

Michael Allen University of Auckland Private Bag 92019, Auckland, New Zealand

VoiceMail:(649) 3737 599 7307 Telephone:(649) 3737 999 Fax: (649) 3737 463 e-mail: ml.allen@auckland.ac.nz

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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,

P.O.Osuji, ILRI

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.

Comments on: Local feed resources and indigenous breeds... by L. Rodriguez J. and T.R. Preston

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From: Frands Dolberg <ifad@zamnet.zm>

Comments on local Feed Resources and Indigenous Breeds

Are there more examples of where indigenous breeds are better adapted to local feed resources?

Yes. Perhaps it is not only better feed resources, but a combination of many other factors like disease, management etc.

Examples coming to mind are in the North Western Province of Zambia, where local poultry, goats and cattle have proved to survive much better than exotic species, while introduction of Guinea Fowl is promising as the bird is resistance to classical killers like Newcastle disease.

In ongoing editing of papers presented at a meeting in April of this year, I noticed examples in ducks from the Mekong Delta of Vietnam and goats from Tanzania.

Are there further models of local crop-livestock-energy systems adapted to local conditions?

There are several sites around Ho Chi Minh City and the Mekong Delta where adoption rates have been good, while - subsequently problems developed in the site Rodriguez and Preston report from, which it would good they explain.

Does the approach described constitute progress in research and extension of sustainable systems?

Certainly. In the parallel Farming Systems Conference, there is today a comment by Janet Riley in which she quotes results of a survey she has conducted. Of 370 scientists interviewed, twice as many reported to work only on-station as primarily with farmers.

It is not "either - or" but getting priorities right that is important. We are into the same discussion in an ongoing evaluation I presently participate in here in Zambia: research does not result in fruitful and applicable results without the on-farm dimension.

While I am at it: Your introductory paper was biased towards natural science to a degree that may not be fruitful. It is OK that farmers in Tanzania use 200 different trees, but have they got access to them to a degree that they can really built their animal production on exploiting them?

The FAO Forest People and Trees Programme earlier this year sponsored a very lively e-conference with more than 400 participants ON CONFLICT MANAGEMENT: Addressing Natural Resource Conflicts Through Community Forestry.

I believe it will be fruitful to invite somebody to review the conclusions of that conference as an input to the present as it will be naive to assume that trees can be used for livestock feeding to a degree that they can really carry improved levels of production just because they are there.

A dimension that needs to be addressed in this conference is the institutional dimension. Few farmers have the elements

that are required to do "integrated farming" and exchanges take place via the labour market in barter, etc. And some are just landless to a degree that they have to procure all resources one way or another from outside the unit of production. These dimensions need to be included in our discussion.

Finally, I have suggested, that you inform the participants of the parallel farming systems conference, which I hope you will do as we have to be careful not to apply a too narrow view on what is on the agenda in this conference.

Frands Dolberg

From: "Speedy, Andrew (AGAP)" <Andrew.Speedy@fao.org>

Reply to Comments

Frands Dolberg:

A good point about resistance of indigenous breeds to disease. But I would stress that we need some more documentation on performance of indigenous breeds. Can you or anyone point to some references?? We are happy to seek them out and distribute abstracts for all the people. We have the FAO library at our disposal.

Can we get access to the information on Vietnamese ducks and Tanzanian goats. Perhaps the authors of the workshop papers would like to contribute here.

Again, you cite examples of local systems in Vietnam. But can we have more data and information?? Our Vietnamese colleagues are connected via the server in HCMC so perhaps they could add some details.

I suspect that much of the work on local systems is not reported but there is a chance to do this here. Janet Riley's survey is worrying. We need to know about environmental interactions, not just about results on one station. Again a plea for more data. I suspect in many on-farm trials, live weight gains are lower and people do not report them but they may be more economic and more sustainable in the local context.

I make no apologies for the bias towards natural science. Systems must first be sustainable in terms of soil fertility and maintenance of biomass. We paid attention to social, economic and market aspects. On the Tanzanian trees: the difference with many of the systems we are concerned with are that they are using feed resources in confinement. Problems in E Africa often arise through extensive use of common resources which leads to overgrazing and removal of the trees. Can ANYONE cite examples of sustainable grazing/browsing systems (where there is high population pressure)??? That is a serious question!

More comments on forage trees later. We have the FAO Workshop on Fodder Trees and will make this available to participants. It is a Windows Help File.

I am not sure I agree with your point about institutional dimensions. Institutions have singularly failed! And farmers often innovate better than institutions, especially lead farmers. We will have a paper later about Tiberio, an innovative small farmer in Colombia. Let us not get into the jargon which is being used in various e-mail conferences. Let us have results and data !!!

Andrew Speedy, Co-moderator

From Borin Khieu <borin@forum.org.kh>

Comments on Local Feed Resources and Indigenous Breeds

Are there more examples of where indigenous breeds are better adapted to local feed resources?

Yes, I think there are many indigenous animals in the tropics that can better utilize local feed resources and it is very important to include the acceptability of these animals in te local markets than the exotic breeds. As an example in 1993-1994, broiler was the major poultry meat production to meet the requirement of UN peace keeping forces and civil (UNTAC). But after that period, the price of meat (broiler) dropped down drastically. While the local chicken is always maintained.

Regarding to cattle, there are three common breeds in Cambodia (Hariana, Brahman and indigenous cattle). Hariana was introduced into Cambodia from India more than 30 years before, but it is not widely spread over the country it is only concentrated along the Mekong river where green forages are found around the year. The indigenous cows are found in many places in the country. The indigenous cattle is smaller than Hariana and Brahman but it can perform work (ploughing) better than the 2 introduced breeds and is more resistant to diseases and poor local feed quality especially in the dry season when rice straw is the only feed commonly available.

Are there further models of local crop-livestock-energy systems adapted to local conditions?

It is important to point out that the model is adapted successfully in the areas where the density of human population is high such as in the East and Southern parts of Cambodia, the areas around Ho Chi Minh City and Mekong Delta.

The model crop-livestock-energy (biodigester) systems works best in Cambodia with the farmers for whom most of the daily income comes from vegetable garden, because they give more emphasis on the value of the slurry from the biodigester. The model is modified a little in Cambodia where the human waste (latrine) is included in the systems. The impact of the models is regarding the four components crop-livestock-human waste-energy.

From: Frands Dolberg <ifad@zamnet.zm>

Further comments

1. To add to Borin's arguments. An experienced expatriate - as far as poultry in Africa is concerned - mentioned yesterday cases parallel to Borin's. As long as there was a market, initiatives to improve poultry worked, but all tended to fall back on the traditional system, once the market collapsed. As usual the experience is not written up.

2. To Andrew: Performance of indigenous breeds: Livestock Research for Rural Development Vol 4.3: 65-69 and 5.2: 39-41 with regard to poultry. Also for poultry there is Tadelle Dessie's recent work from Ethiopia (understand we will get a paper from him).

On Vietnamese ducks, I had work by Mr. Xuan Men Bui, Cantho Univ in mind and on goats it was Dr. Georg C. Kifaro c/o:

svsarwatt@hnettan.gn.apc.org

I had in mind. Dr. Poul Henning Petersen of the Danish Agric Univ (php@kvl.dk) is involved in a research project on local goats in East Africa.

"Again, you cite examples of local systems in Vietnam. But can we have more data and information? Our Vietnamese colleagues are connected via the server in HCMC so perhaps they could add some details."

Mr. Xuan An Bui (an%sarec%ifs.plants@ox.ac.uk) can add some with regard to the biodigester and a Danish student Mette Ide Lauridsen (ide@ps.aau.dk) has just completed a comparative evaluation of different sites in Vietnam. Mr. Xuan An Bui and Lylian Rodriguez have just completed an evaluation of the technology in Bangladesh.

"I am not sure I agree with your point about institutional dimensions. Institutions have singularly failed!"

NGOs are also institutions and so are farmer agreements on regulations of exploitation of trees! Institutions are not only the "modern" ones.

" Let us not get into the jargon which is being used in various e-mail conferences. Let us have results and data !!!"

I think I understand your point, but not so sure I agree. Too simple and perhaps self-righteous.

Frands Dolberg

From Rene Sansoucy and Christophe Dalibard

Comments on Indigenous Livestock breeds and Local Feed Resources:

One of the most striking examples of the relation between these two factors probably comes from Haiti. In the early 80's the whole pig population had to be slaughtered because of an epidemic of African Swine Fever. After some years and with the assistance of some donor countries and of International Organizations, it was decided to reintroduce pigs using exotic "improved" breeds and incentives were provided for feeding them with concentrate feeds.

The problem is that Haitian small farmers were not used to this type of animal and, more importantly, they could not afford to buy the concentrates. Interestingly enough, after a few more years, most of the "improved" pigs had disappeared or had reverted to a type close to the former local pigs (known as "porc planche' because they were very thin).

In the meantime, another type of pig was introduced. It consisted of crossbred Caribbean Creolle x French x Chinese breeds which was closer to the former local breed. It was more easily adopted by small farmers who have nothing else to feed their pigs besides the kitchen left-overs.

Alfredo Mena and his Haitian colleagues could *indeed* elaborate on this topic.

Rene Sansoucy Christophe Dalibard

From Lylian Rodriguez <lylian%sarec%ifs.plants@ox.ac.uk>

Comments on second paper

1. Regarding Frands Dolberg's comments on the second paper:

"*Are there further models of local crop-livestock-energy systems adapted to local conditions? There are several sites around Ho Chi Minh City and the Mekong Delta where adoption rates have been good, while - subsequently problems developed in the site Rodriguez and Preston report from, which it would good they explain"*

Thanks Frands for asking us to go into more detail about it. Yes, models of crop-livestock-energy systems - specifically the plastic biodigester - have different impacts in different environmental and socio-economic conditions. But one of the

main aspects is how the technology is introduced in an area, and even more important the technicians' attitudes. We have good examples of both successes and failures in Colombia, in Vietnam and in Bangladesh but I won't go into more detail because there will be a specific section in this conference where we'll have the opportunity to go deeply in this subject.

"Does the approach described constitute progress in research and extension of sustainable systems? Certainly. In the parallel Farming Systems Conference, there is today a comment by Janet Riley in which she quotes results of a survey she has conducted. Of 370 scientists interviewed, twice as many reported to work only on-station as primarily with farmers."

On-farm research, or much better the "participatory learning process" (Pretty, 1995b), is the starting point for a clear understanding of the situation and to define research priorities, but it is not that simple and there are many interacting aspects such as:

- Human factors of the outsiders and the target group: culture, communication and attitude are essential factors that can stop or make the process work.

- Environmental factors such as rainfall distribution, temperature, storms and floods will affect the results and lead some scientists to decline undertaking "on-farm" research, but they will then miss the reality.

- Technical aspects such as: communication with other scientists working in the same way, facilities to get relevant information/references and more specific aspects such as laboratory facilities that are a constraint in developing countries. Knowledge of there existence may lead the researchers to allocate them a higher priority than they deserve in order to obtain reliable data. But the other side of the coin is, what is the meaning of reliable data produced out of context?

- Economic resources such as access to adequate credit which is also one of the main constraints because it is not available and the knowledge (Hashemi, 1996) about it is very weak in both outsiders and in the target groups, contributing to the complexity of a solution.

- Feed resources (availability, quality, prices)
- Animals (health conditions, breeds, age)
- Water (quality, availability), for instance for biodigesters water is an important resource.
- Soil (type, fertility)

These aspects interact both positively or negatively in the process. However, experience leads us to conclude that these issues are best addressed within a framework of 'Farmers First' (Chambers) and learning approaches (Dolberg), where the research starts in the villages and the station and the laboratories play referral and consultancy roles.

"Finally, I have suggested, that you inform the participants of the parallel farming systems conference, which I hope you will do as we have to be careful not to apply a too narrow view on what is on the agenda in this conference"

It could be interesting for us to know about this conference.

Lylian Rodriguez

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

Comments on Local feed resources and indigenous breeds

(comments sent in French and summarized in English by the Conference Coordinators)

Are there further models of local crop-livestock-energy adapted to local conditions ?

Factors such as population pressure, availability of resources, objective of production and socio-economic conditions are essential considerations when choosing among available technical options for mixed farming systems. In areas with very

high population pressure, where soil fertility has decreased a lot, as is the case on the central plateau of Burkina Faso, small livestock such as poultry and small ruminants play a major role as sources of income, for recycling of crop residues and production of manure (the only available fertilizer in these areas), and as agricultural risk insurance. In areas under lower population pressure, livestock are still important, especially cattle.

Are there further examples of participatory development which have led to the development of such systems?

10 years of field research shows that producers' participation is a long term process which requires appropriate mechanisms when initiated and for sustaining it.

Does the approach described constitute progress in research and extension of sustainable systems ?

The approach described is original and very fruitful. According to our experience, the approach should concentrate on the beneficiaries' needs and priorities, the assessment of local opportunities for production and the development of mechanisms (benefiting from farmers' expertise) for identifying solutions that optimize resources locally available.

Jean S. ZOUNDI, Zootechnicien, Attache de Recherche INERA 03 BP 7192 Ouagadougou 03 BURKINA FASO Tel. : (226) 34 02 69 or (226) 34 02 70 Fax : (226) 34 02 71

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From Saadullah <saad@drik.bgd.toolnet.org>

Comments on Local Feed Resources and Indigenous Breeds

Where indigenous animals are better adapted?

Yes, I agree that the local animal are better adapted and also are more acceptable to the local market:

To understand these points, first we must realize the value of livestock-keeping in developing countries. For example livestock is valued for one or several of the following traits: capital, credit, traction, milk, meat, hides and skins, fuel and fertilizer. The real need is to understand the basic principles of the livestock production process, to identify the major constraints within the different existing systems and to demonstrate the economic value of appropriate technologies based on the use of local resources.

In fact the farmers possess a large amount of information that can help to increase the productivity without resorting to new technologies and advice from technical experts who have little understanding of local conditions. It has been observed in many cases that the indigenous technology is more sustainable and appropriate to solve the location-specific problems in many developing countries. These adopted technologies are not based on research, but on careful observations and experience from farm family, parents and friends for generation to generation.

The farmer wants an animal that utilizes crop and homestead wastes, improves his farm income and is multi-purpose. For obvious reasons, the local indigenous animal serves these purposes. In Bangladesh, cross breeding (without any definite programme) has continued for more than three decades. Unfortunately one can hardly find cross-bred or exotic animals in the small farms or in the village cattle market, except in few governmental farms. As regards feeding, they have several indigenous technologies which demand improvement under local conditions. It has also been shown by several workers in Bangladesh that the indigenous animals are more efficient in utilizing local feed resources. I am citing a small table which agrees with the farmer's economic concept to improve his farm income by raising local animals. I think Mr. Frands Dolberg can give more information.

1. Bangladeshi indigenous cattle (Ref: Saadullah 1984)

Diets on dry matter basis

Feed : 92% rice straw

Live weight gain per day (g) : 203

Feed conversion (kg DM/kg LW): 9

Remarks: they are also good for traction, transport, etc.

2. Steers USA (ref : Lesoing et al 1981))

Diet on Dry matter basis: 78% straw

Live weight gain per day (g): 650

Feed conversion (kg DM/kg LW): 15

3. Hereford X Angus (Garret et al 1979)

Diet on Dry matter basis: 72% straw

Daily live weight gain (g): 594

Feed conversion ratio : 18

The results will be judged by the farmers. Feeding systems utilizing crop residues are based on:

i) Socio- economic conditions which determine the level of input for production;

ii) Agro-ecosystem which determines production from natural ecosystems.

It is necessary to analyze the available indigenous (traditional) and new technologies carefully before recommending adoption by the farmers. It is also important to refine or modify them according to the need of the farmers, keeping in view the resources available to them.

Saadullah

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

Comments on indigenous breeds

On the question of indigenous animals being better adapted to prevailing climate and feed resources there is a great deal of information both with chickens, cattle, sheep and goats. Many years ago we observed that the small cattle in Bangladesh (150-200 kg mature weight) could eat almost as much straw as Holstein heifers weighing 400 kg. The gut volume of the cattle in Bangladesh was 30% or more of live weight while it was no more than 20% in the Holstein cattle. So-called exotic cattle are being selected against gut volume as a high killing-out percentage is considered positive in selection indices. No wonder they fail when concentrate is scarce or non existent! Yet they are called "upgraded".

Dr E R Orskov Rowett Research Institute Bucksburn, Aberdeen AB21 9SB, UK Tel. +44 1224 71661 Fax +44 1224 716687 http://www.rri.sari.ac.uk/xbc/

From Brian Ogle <Brian.Ogle@huv.slu.se>

Comments on indigenous breeds

In response to Andrew's request for hard data on the performance of indigenous breeds under smallholder management and feeding conditions, here are a few examples from SAREC supported studies:

1. Tam Hoang chickens, Tuyen Quang province, North Vietnam

This is an improved "indigenous" (first question - how do you define indigenous ? most "local" breeds were introduced from outside at some point in time, in some cases quite recently) breed introduced to Vietnam recently from neighbouring S.China, and currently being distributed to Women's Union groups by the National Institute of Animal Husbandry, Hanoi, and evaluated (by Do Viet Minh) in improved village level scavenging systems. Some comparisons have been made with a Rhode Island Red cross (Rhode-Ri). Farmers were not interested in supplementing their local birds.

Annual egg production (hen housed average)

	Tam Hoang	Rhode-Ri
Scavenging only (SO)	77	81
S + 30g/day soybean meal (SBM)	117	159
S + 30g/day maize meal (MM)	111	83(?)
S + 15g/day MM + 15g/day SBM	144	-
Mortality, %	3.4	5.0

The birds were vaccinated against Newcastle disease, confined at night, and had about 15 sq m /head of scavenging area (they were confined in large gardens). Local birds produce around 40-50 eggs per hen annually (SO). The reason for the lack of data for protein + energy supplementation of the Rhode-Ri breed is that few families were interested in keeping them, in spite of their higher production - reasons given being "they are not so good at scavenging, and need to be given more feed", "the Tam Hoang hatch their own eggs"and not least that "Rhode-Ri eggs sell for only around 800 VDong each, compared to 1200 Dong for a smaller Tam Hoang egg" (!) (1US$=11,000

Dong). Also male Tam Hoangs command a premium price on slaughter - the meat being considered superior to that of local and exotic breeds. A success story then for a local-ish breed, demonstrably superior to both the unimproved local type and an exotic cross.

Supplementation of indigenous scavenging hens (again with locally produced feeds) in a rather more hostile environment in the central highlands of Ethiopia (work by Tadelle Dessie - I was waiting for some comment from him, but e-mail contact seems to be a problem at the moment) showed similar results - 48 eggs per hen per year with scavenging only, increasing to 78 with supplementation with noug cake, 96 with a maize meal supplement, and 114 eggs with both the protein and energy supplements - indicating that energy rather than protein deficiency is the problem (the opposite was found in Tuyen Quang). All previous attempts to introduce exotic breeds into the area through village cockerel schemes had failed due to their susceptibility to disease and parasites - and not least predators, (eg. white feathered birds are easily spotted by birds of prey, and exotics are less adept at hiding) and their poor ability to scavenge.

So, in the case of *Gallus domesticus*, where even exotics should be well adapted to tropical climates, indigenous breeds have considerable advantages in scavenger based systems, but their productivity can be improved by supplementation with locally produced feeds, and also by selective breeding (the Tam Hoang has been improved, without apparently losing any of its advantages in village systems). The higher levels of production shown to be possible also require improved management, eg. in the form of provision of water, night shelter and vaccination (when available) - which farmers are prepared to provide, although previously local hens were not considered to be worth the extra investments.

Where other species are concerned the situation is more complicated, and one of the common problems seems to be that cross breeds often perform significantly better than indigenous breeds under village conditions, even with only fairly modest improvements in housing, management and feeding, which reduces the incentives in keeping pure indigenous breeds.

Even though crossbred cows suffer from heat stress in certain environments, this has not been a problem in the

cases outlined below.

2. Smallholder dairy confinement systems in Tanzania.

2.1. Stall-fed dairy cows, (HADO project)

Extensive grazing of indigenous goats and cattle (mainly Tanzanian Shorthorn Zebus (TSZ), giving around 0.5L of milk per day but also performing other - eg.socio-economic, functions) have been banned from large areas of semi-arid central Tanzania due to erosion problems. Improved dairy cows kept in confinement systems were introduced, but due to problems in obtaining sufficient numbers of improved animals farmers were allowed to bring in TSZ cows. Under similar conditions of (simple) housing, management and feeding (basal feed of cut grasses and weeds, sugar cane tops, legume tree leaves and pods, maize/sorghum stover and pigeon pea vines and small amounts of locally produced maize bran and sunflower seed cake), mean daily milk yields were (n=25) 8.7 kg for Tanga crosses (50 - 75% Holstein or Ayrshire/Jersey x local TSZ) and (n =21) 2.5 kg for the TSZ. Lactation lengths were also longer (377 vs 270 days) for the crosses, and mortality of cows and calves over a period of several years virtually zero. Farmers cross their TSZ cows with F1 bulls, and will eventually end up with an animal with around 50% exotic blood (information provided by Tekie Gebregziabher). Although numbers of TSZ cows are high enough at the moment, similar situations in other countries are resulting in the disappearance of indigenous breeds (eg.the Sahiwal in Pakistan).

2.2 Dual purpose improved (crossbred) goats

Poorer farmers in the drier HADO areas either were unable to afford or had insufficient land to support a confined cow. They were also unwilling to keep indigenous goats in confinement, but were persuaded to try stall-fed crossbred (Anglonubian x "blended") dual purpose goats. Mean milk yield on local feeds (cut grass, cane tops, leaves and pods and 0.5 kg /day of a mixture of maize bran and sunflower seed cake), was over 0.6 kg /day, and the male kids could be sold for breeding or meat at very high prices (information from Ezekiel Goromela).

3. Mong Cai pigs

Lylian Rodriguez described some of the admirable characteristics of this breed, but I don't think she mentioned that due to its extremely low mature body weight and high carcass fat it is no longer very attractive as a meat animal, even in most rural markets. However, due to its excellent prolificacy and mothering abilities (and low maintenance requirements, easily met in pregnancy by forage (eg duckweed) based diets) it is normally crossed (using AI) with the Yorkshire or Landrace, the offspring growing well (450g/day) eg on low protein cassava root silage diets under village conditions (data presented by Nguyen Thi Loc) - and producing a reasonably lean carcass. In spite of the advantages of the sow in such crossing programmes the breed has virtually disappeared from South Vietnam (and numbers are falling in the North), as it is obviously not economically attractive to rear pure Mong Cais.

The question then is how to conserve these indigenous breeds and their valuable characteristics in the face of the undoubted (in most (?) cases) economic advantages of crossbreeds, even under village conditions?

PS. I assume Bui Xuan Men will send in some information on local vs exotic ducks in the Mekong Delta?

Brian Ogle, Dept. of Animal Nutrition and Management, Box 7024, SLU, 750 07, Uppsala.

From Rena Perez <71055.111@compuserve.com>

Comments on local feed resources

In Cuba, as a protein supplement for cane juice-based diets, farmers are beginning to use 8-9 week-old soybean forage. To get around problems associated with thetrypsin inhibitor in the whole bean, they simply plant a 7-row plot of soybeans every week! After harvesting plot 8/9, it is simply replanted, which means that in a very small area a source of protein is constantly available. An *in vitro* nitrogen digestibility (pigs) gave 67%, quite unbelievable for most forages. Perhaps, soybean forage, rather than the less user-friendly whole soybean, might provide needed protein for pigs, hens, ducks and rabbits, and in the tropics which is where the authors state the "soybean is not well adapted" ???

Rena Perez

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

Comments on research

My work is done on my farm and farms of my clients here in Hawaii. I have made some major breakthroughs in terms of reducing fallow for milpa (slash and burn), by planting *Sesbania sesban* at last cultivation of a row crop and then once established, bring in the St. Croix hair sheep. To feed on both the living mulch used for the soil improvement, in my case *Desmodium* sp. in the wet season and slash forage from *S. sesban* in the dry season. The end result is a high quality meat animal . The St.Croix is originally from Africa and was brought over to the Virgin Islands 400 years ago. We now have more in Hawaii than in St. Croix. See my web page for details about these sheep. At any event I believe that there are many solutions to these problems, I have them, the trick is getting farmers to do it, researchers just want to keep the research going, not really solve our problems. When farmers or applied researchers come up with something, they get no support or respect for actually solving the problems. As a research agronomist, entomologist and agroecologist, I was employed by industry to solve problems, develop products, etc. I am sure these comments will start some discussion. By the way, daily observation makes it clear that here in the sub-tropics, grass, coffee, and a number of other crops do best in shade, this is partially due to ultraviolet saturation in excess of the plants need, shade actually provides better growth and possible nutrition. Look forward to comment.

Robert H. Faust Ph.D. Agroecologist Faust Bio-Agricultural Services, Inc. P.O. Box 800, Honaunau, Hawaii 96726 U.S.A. 808-328-2083 http://www.wp.com/bioag/

From Francisco A. Moog <famoog@globe.com.ph>

Comments on Rena Perez' comments on local feed resources

I am pleased to hear from Rena that soybean forage is being used in Cuba. I believe this would be more relevant than whole soybean in some areas. Apart from the advantages Rena has pointed out, considering the length of time (110 days) to grow the crop for beans there could be at least be 2 cropping cycles for forage soybean. In addition, there will be no crop failure at all, we can obtain forage harvest though lower yields when adverse conditions (like drought) occur. Her comments gave us an idea. I showed it to one of my staff, Felix Valenzuela. We agreed we will try it for pigs. I look forward that Rena will provide us more information to guide us in our future undertakings.

Francisco A. Moog Bureau of Animal Industry, Queson City, Manila Philippines

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From A.D. Salman <FAO-IRQ@field.fao.org>

Comments on Indigenous breeds and feeding

I would like to make a comment on the question of indigenous animals being better adapted to prevailing climate and feed resources. During summer in Iraq, Awassi sheep depend mainly on utilization of crop residues (wheat and barley) by stubble grazing which coincide with mating season when ewes come to estrus due to improvement in their body condition. This type of feeding lasted from June-October.

The farmers' practice is that no supplement is given during this time of the year, because they consider that stubble grazing is a natural flushing for their animals.

A.d. Salman, Ipa Agric Research Center, Baghdad, Iraq P.o. Box 39094

Note from the moderators: this is especially the case when stubble grazing is done just after harvest and fallen grain is present on the ground in significative quantities.

From Rena Perez <71055.111@compuserve.com>

Comments on Rodriguez/Preston paper

One argument related to the inefficient use of *Lemna* by pigs in Vietnam was because the breed used in the experimental work was an "exotic" breed, I believe, Large White. Interestingly, Becerra et al (1990) in LRRD showed that *Azolla*, similar but maybe even nutritionally inferior to *Lemna*, could be used to provide fattening pigs some 30% of the protein found in soymeal. The results were: 568 g/d when fed 11 kg cane juice, 350 as opposed to 500 g protein supplement, and 5.2 kg Azolla (control 540 g/d). The question is: weren't the Colombia pigs, also, more or less, "exotic" pigs?

The second comment is: when the United States and China re-established diplomatic relations, Chinese sows were taken to the US, via France for several years, for purposes of crossbreeding. The reason was that the Chinese sows produced an average litter size of 18 live piglets. Obviously, there is something in Asian swine genetics other than the "low nutrient density" of the average diet.

From Stephen Swan <swans@wave.co.nz>

Comments on Indigenous breeds of poultry

I was in Bangladesh in July '96 to see how Hans Askov Jensen (with BRAC and the DLS) was getting on with the SLDP Danida/IFAD poultry project. I worked on the same "project subject" from 1980-87 with FAO/UNDP assistance. We both came independently to a conclusion about supplementary feeding of scavenger poultry. This was based on the fact that poultry have an inherent ability to select between protein, energy and $CaCO_3$-rich ingredients of their nature-supplied diet at any particular time of the year/season /farm harvest cycle. By offering them a choice of each type of concentrate in a clay or wooden bowl, they can optimise their diet for maximum productivity (by their standards). Preferably at the end of a day of scavenging. This reduces the need for analysing the crop contents of a chicken in each season to decide on diet imbalances (if this is a valid basis for such a decision). Hans Askov is keen to try out this "cafeteria" system in his project area.

I was very interested to read about the Tam Hoang chickens of Tuyen Quang province in North Vietnam:

Any more data?

Did they use the V4 or I2 heat tolerant vaccine?

And if so, mixed with what type of feed or by eye-drop?

To comment on Brian Ogle's statement: "common problems seems to be that cross breeds often perform significantly better than indigenous breeds under village conditions". This could be the hybrid vigour effect which increases production and survivability characteristics. I don't mind this as it increases the chance of the "improved" genetic material entering the village gene pool, where the real test of these gene's benefits to the farming system will soon be put under whatever selection pressure the farmer's environment cares to provide. Those genes less supported will leave the pool. This has been going on for years with all the well-meant "improvement" schemes be they cockerel exchange or fertile egg distribution. Unless the management can support the more productive genes, they will fade away.

I can send you more data on the Ethiopia experience if you are interested.

Comments on: On-farm experiments in the use of local resources for pigs in Vietnam by Nguyen Thi Loc

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From Rena Perez <71055.111@compuserve.com>

Comments on Nguyen Thi Loc's paper

The interesting problem appears to be that at certain times of the year there is an overabundance of a cheap source of energy: cassava.

1. Cassava

Why process the cassava root? Fresh cassava can be used successfully. The low cost of cassava is emphasized throughout the study, however, the performance experiments used cassava root meal?? If cassava cannot be grown year-round, why not organize and/or emphasize the fattening phase when this carbohydrate source is plentiful, and turn cassava into pork, easier to store, etc. I have emphasized this same approach for cane juice, particularly for countries that have a 6-month cane harvest, that is, to fatten pigs during the "carbohydrate" harvest, slaughter at end of harvest, and only keep reproductive herd until next "cheap carbohydrate cycle". In Cuba, it is the daily negative selection of cassava roots, destined for the lunchroom, that go to the pigs. Perhaps, because our operations are larger, 30 to 40 pigs, there is more room for adjustment and/or modification. However, if the operation is for 2 to 4 pigs, why not leave the cassava in the ground, and harvest as in Angola, i.e., the daily removal of outer, larger root pieces.

2. Fishmeal

What about feeding your pigs whole, fresh fish or fish and/or fish offal preserved in A molasses? In Cuba, both techniques are used. For pigs, a small fish morning and night, resolves the problem! Two weeks prior to slaughter remove the fish from the diet. Very simple.

3. Two additional comments

Better results can be had by feeding your protein supplement twice daily. One of our cane coop pig diets is fresh cassava roots and fresh soybean forage, 2 kg, twice daily.

From Jean Zoundi <zoundi@burkina.coraf.bf>

Comments on third paper by Nguyen Thi Loc

Are the on-farm experiments an effective test of local feed resources within systems?

Yes, this is important for optimizing the local feed resources. Nevertheless, it is also important at some stage to carry out research that cannot be done on-farm: this essentially concerns the assessment of the role and of the potential of each feed resources within the diet for a particular production. This often requires sophisticated laboratory works and is necessary before formulating diets and testing them on-farm. The advantage of on-farm research is that they easily permit the integration of socio-economic environment and all the more it permits the researcher to assess the potential of adoption of research results.

Is cassava an appropriate plant resource within integrated farming systems, given the problems of soil erosion associated its cultivation (and competition for human food and starch production in some other countries)?

Yes, there are some regions, for example the humid tropical areas where the availability of cassava permits its use for animal feeding. In this case, this practice is economically and socially justified. My experience on the optimization of local feed resources shows that it is very important for any feed resources to take into account these two factors (economical and social). It is important to think in terms of opportunity.

Is the flat rate feeding of protein supplement (200g/day) the best method for local system ? Should it not increase with time/weight?

According to logical scientific principals, these levels should vary with time/weight. But there are specific constraints for on-farm research especially if we take into account the future use of research results. Methodological choices have to be made in order to increase the potential of adoption of research results by the producers.

Jean S. ZOUNDI, Zootechnicien, Attache de Recherche INERA, 03 BP 7192 Ouagadougou 03, BURKINA FASO Tel. : (226) 34 02 69/34 02 70 Fax : (226) 34 02 71

From Karl Muller-Samman and Carlos Iglesias, Cassava Program, CIAT. Forwarded by Carlos Lascano <c.lascano@cgnet.com>

Comments on paper by Nguyen Thi Loc

Is cassava an appropriate plant resource within integrated farming systems, given the problems of soil erosion associated with its cultivation (and competition for human food and starch production in some other countries)?

Cassava has a reputation as "soil erosion inducing" crop. This image not only exists due to the characteristics of cassava itself, e.g. deficient an slow soil cover in the first two-three months but is to a large extent due to the circumstances of its cultivation. Most of the times cassava is the last crop in a series, after the soil has been impoverished. Though still producing something for the farmer, under those circumstances it certainly will result in severe soil erosion. So it is not the crop itself but the circumstance that lead to its cultivation in degraded soils, since cassava adapts reasonably to those conditions.

Research on soil conservation practices for hillside or upland cassava-based cropping systems has continued both in Colombia and several Asian countries.

This work focussed on the identification and evaluation of appropriate technologies which include relay cropping in unmechanized systems and appropriate soils, forage legume green manure crops, grain legume intercrops, mulch of weeds and crop residues and the planting of live barriers. Results on both continents have shown that soil erosion in cassava- based cropping systems can be greatly minimized by cultivating cassava in contour ridges, with grass barriers, or by in situ production of mulch by inter-planting cassava with green manure species. Agronomic practices that result in rapid canopy closure, such as selection of healthy, vigorous stakes from fertile plots, the use of appropriate genotypes, application of fertilizer in poor soils and closer spacing, also reduce soil loss. More recently excellent results have been obtained after two years of a grass/legume rotation. The highly productive legume components made soils more productive and less susceptible to erosion for two subsequent cassava cropping

cycles. This effect was more pronounced with minimum tillage but also was very clear with tillage.

These research efforts on soil conservation are currently continuing in Colombia with the financial support of BMZ, Germany. On-farm evaluation of soil conservation practices are being conducted on three different locations on hilly lands in the Cauca Department in collaboration with farmer communities, NGO's, national agencies and CIAT's Hillsides Program. In Asia, a five-year soil conservation and management research project in collaboration with several Asian national programs was initiated in 1994 with the financial support of the Sasakawa Foundation of Japan. The projects focuses on the development of a farmer participatory methodology for the selection, testing and adaptation of management practices that are most appropriate under the local physical and socio-economic conditions.

So in brief, we recognize soil erosion is a potential problem for the intensification of cassava production under particular circumstances, but there is enough information to help us minimize that problem.

From Gerard O'Brien c/o <c.lascano@cgnet.com>

Comments on the use of cassava as animal feed

I'd like to comment on two contributions made so far:

1. Issues brought to mind by Nguyen Thi Loc's third paper (On-farm experiments... pigs in Vietnam), and questions raised in response to it.

(a) Dr. Nguyen states (p.3-4) that sun-drying of cassava during the rainy season can be very slow, possibly producing aflatoxin contamination. This is true. She also states that artificial drying is very expensive, and thereby renders cassava meal uncompetitive in relation to cereals. This is also true. However, there is a third option: combined (or "mixed") drying. In combined drying, the cassava chips are first sun-dried for one day (reaching about 20-25% moisture). On the second day, they are dried artificially the rest of the way (down to around 12%

moisture, for example). This method, by firstly employing one day of natural drying to eliminate the majority of moisture, avoids the risk of fungal growth, produces a highly stable final product, and is considerably cheaper than artificial drying.

(b) Among the questions raised by the moderators, mention was made of cheap local sources of protein (question 3). If the livestock in question were cattle, then one obvious potential local source of protein is cassava leaves. These have been shown to be a good protein source for mainly ruminant animals. However, I understand that they are not so good for monogastric animals.

***Side Issue*: Cassava meal, as a constituent of composite feedstuffs, can produce a highly competitive product in comparison to cereal-containing feeds. Recent investigations by the Colombian scientist Julian Buitrago, together with the American Soya Association, indicate that:**

(i) with chicken feed, 40-50% of cereal input can be substituted with cassava meal, as long as the protein component is toasted whole soya bean;

(ii) with pig feed, sorghum may be completely replaced by cassava meal, as long as the protein component is toasted whole soya bean. Doctor Buitrago's company intends to produce these cassava/soya containing feeds commercially.

In both cases, major savings are presented.

2. Dr. Rena Perez' comments

Dr. Perez rightly points out the problem of cassava "gluts". These, of course, can result in grave problems for the cassava growers, as the price of the roots tends to decrease sharply. There is often a lot of waste. Her suggestion of using the roots fresh, harvesting only small amounts daily in order to avoid losses due to rapid post-harvest deterioration, would of course be suitable if:

(a) the cultivar(s) used is/are relatively low in cyanogen content;

(b) one is farming relatively small numbers of animals, close to the cassava growing area (minimal transport required in order to minimise post-harvest deterioration);

(c) there is no pressure and haste to re-plant on the cassava farmer's land as soon as possible (i.e. if the farmer can allow himself the relative luxury of gradually harvesting his crop during a period of perhaps 1-2 months).

Gerard O'Brien, Cassava post-harvest specialist, CIAT

From Rena Perez (71055.111@compuserve.com)

Cassava As Animal Feed (comments on O'Brian's comments):

I agree with Gerard O'Brian on all the points he mentioned related to the use of fresh, whole cassava roots as an energy source for pigs. My comments were definitely focussed on the small-size farm operation, only.

I thought the comments on one-day sun drying to be followed by artificial drying an interesting approach. What about storing the one-day-dried cassava chips in molasses for future use? Would it work? In Cuba, for pigs, we store small fish or fish offal in about a 50:50 (by volume) arrangement for months with no problems. A similar idea with cassava chips, perhaps a 70:30 or 80:20 mixture, only to coat the chips, might serve to reduce fungal growth and even increase palatability. And interestingly, molasses and cassava often coexist in the same farm/area in sub tropical/tropical countries.

Rena Perez Ministry of Sugar, Havana, Cuba

From Carlos Sandoval Castro <bcasso@tunku.uady.mx>

1. Comments on O'Brian's comments (drying cassava):

Cassava dry-off is a serious problem when thinking of making use of it on an industrial scale. The proposal for sun-drying, and molasses preservation looks fine. I would like to suggest a further system which if not new is sometimes forgotten.

For "solar ovens" the principle is simple. Big boxes covered inside with aluminium foil, the bottom of the box painted black, and covered with a transparent glass of plastic lid.

This oven can reach temperatures around 100^{o}C and can therefore cook the cassava and get rid of cyanogenic compounds. But probably somebody can think of some modifications to convert them into "solar dryers."

The technology is widely used nowadays in some African countries and in some areas of Mexico for cooking in small villages. Why not cook cassava for animals: it will be cheap, non-pollutant and will probably increase performance.

Carlos Sandoval Castro. E-Mail: bcasso@tunku.uady.mx Faculty of Veterinary Medicine and Animal Science University of Yucatan, Mexico

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From Denis Bastianelli <bastienelli@cirad.fr>

Comments on use of cassava leaves

G. O'Brien comments on the possible use of cassava leaves raise an important aspect : 10-30t /ha/year of leaves can be obtained with a protein content as high as 17-40% DM. This is an important resource which is very often wasted.

It seems obvious that the potential is important for ruminants, but the high protein content could also be valuable for monogastric animals despite a high fibre content (around 20% DM).

We are at present interested by this topic and I would be grateful if someone could provide information on practical

experiments of use of cassava leaves in pig feeding.

Denis Bastianelli, CIRAD-EMVT, France

From Rider Perez <Rider@mailbox.uq.oz.au>

Comments on comments from Denis Bastianelli, on use of cassava leaves

I have been working with polyphenolic compounds such as condensed tannins in tropical fodder trees and forages and with grain legumes. I have experience in feeding ruminants and more recently I am working with poultry.

I think cassava leaves have a great potential for animal feed particularly in tropical environments. The main problem with cassava leaves is its high tannin contents in leaves which interfere with protein availability for animals. Useful paper to read is:

> **Reed, J.D., McDowell, R.E., Van Soest, P.J. and Horvath, P.J. (1982)Condensed tannins: A factor limiting the use of cassava forage. Journal of the science of the food and agriculture 33: 213-20**

Rider Perez, University of Queensland, Australia

From Robert H. Faust

Comments on comments from Denis Bastianelli on use of cassava leaves

Concerning the use of Cassava leaves for livestock feed: my work here in Hawaii with St. Croix Hair Sheep have clearly shown that Cassava leaves is an ideal dry season feed for tropical sheep and the high fiber is a plus for sheep. The other forage that has potential is Avocado (Persea americana) which we use quite successfully in the

dry season. Keep in mind that Hair sheep are very effective in the tropics and less of a problem than pigs, which here are pests that destroy the forests and crops.

Robert H. Faust Ph.D. Agroecologist Faust Bio-Agricultural Services, Inc. P.O. Box 800, Honaunau, Hawaii 96726 U.S.A. 808-328-2083 http://www.wp.com/bioag/

Comments from Paschal Osuji on Denis Bastianelli's request:

Part of the questions he asked might be answered in the following Workshop Proceedings:-

> **Barry Nestel and Michael Graham (eds) (1977) Cassava as Animal feed: Proceedings of a workshop held at the University of Guelph, 18-20 April 1977. Ottawa, IDRC, 1977. 147p.**

Additional references are available from the reviews contained in the book.

Paschal Osuji, ILRI Debre Zeit

From Nguyen Van Lai, Rodriguez Lylian and Preston T R

Comments from Vietnam group on Denis Bastianelli's comments

"G. O'Brien comments on the possible use of cassava leaves raise an important aspect : 10-30t /ha/year of leaves can be obtained with a protein content as high as 17-40% DM. This is an important resource which is very often wasted."

It seems obvious that the potential is important for ruminants, but the high protein content could also be valuable for monogastric animals despite a high fibre content (around 20% DM).

"We are at present interested by this topic and we would be grateful if someone could provide information on practical experiments of use of cassava leaves in pig feeding."

From Vietnam, we have published recently a paper on cassava leaf meal and cassava leaf silage at up to 45% replacement for soya bean meal in pig diets based on cassava root meal (Bui Huy Nhu Phuc, T R Preston, R B Ogle and J E Lindberg 1996. The nutritive value of sun-dried and ensiled cassava leaves for growing pigs. Livestock Research for Rural Development. Volume 8, Number 3:26-32; on Internet at: htp://ifs.plants.ox.ac.uk/lrrd/lrrd.htm). No change in N retention at up to 30% substitution of soya protein but reduction at 45%. Protein was in range 24-32% in DM and fibre 9-14% in DM. There were indications of higher digestibility of N for ensiled compared with dried leaves.

More recently we are feeding cassava leaf silage as only protein supplement to native (Chinese type) pigs fed a basal diet of sugar cane juice. Intakes (fed ad lib) were high enough to provide 10% protein in the diet dry matter which is close to optimum when protein with optimum balance of AA is fed (Cassava leaf protein is better than soya bean protein in AA balance). Detailed results will be in LRRD 1997, 9(1).

***Nguyen Van Lai, Rodriguez Lylian and Preston T R in Vietnam*.**

From: Velmurugu Ravindran <velmurug@camden.usyd.edu.au>

Comments on cassava leaf products

I have enjoyed these proceedings (and, in particular, the comments and practical experiences of so many from various parts of the world) very much. It had been a good learning process for someone like me who work mainly at the research station level. As someone who has worked on cassava leaves for the Ph.D dissertation, I would like to contribute the following to the on-going discussion on use of cassava leaf products in swine feeding. Hopefully people currently working with cassava leaves may find some of this useful.

1. I agree (with Denis Bastianelli, CIRAD-EMVT, France) that cassava leaves represent a wasted feed resource in tropical animal production systems. For a non-leguminous plant, the leaves contain high levels of protein - an average of 21% CP (with values ranging from 15 to 40% CP). The stage of maturity at harvest is the major factor contributing to this wide variability.

2. The protein quality is reasonably good, but marginally deficient in methionine, for monogastric animals. An important feature to note is that it is a rich source of lysine - the most limiting amino acid in swine diets. But it must be noted that the stage of maturity at harvest will significantly influence the amino acid profile (see Ravindran & Ravindran. 1988. Food Chem. 27: 299-309).

In general, the amino acid profile is better or compares well with most common protein sources available in the tropical regions. Unfortunately, it is inferior to soyabean meal in protein quality. Our assays with adult cockerels in Virginia Tech University, USA, have shown that the protein and amino acid digestibilities (%) of cassava leaf meal is much lower than those of soyabean meal. Just to give some values for cassava leaf meal & soyabean meal, respectively: nitrogen, 67 & 89; methionine 58 & 92; lysine, 67 & 89; Isoleucine, 82 & 92; leucine, 71 & 90; Threonine, 66 & 90. These differences are probably due to the (a) high fibre and (b) condensed tannins (see Reed & co-workers. 1982. J. Sci. Food Agric. 33: 213-220) in cassava leaves. I would expect that these digestibility data are applicable to swine feeding as well.

3. This means that the level of cassava leaf meal that you can include in swine diets will depend on the type of protein supplement that is to be replaced. For example, as a replacement for a low-to-moderate quality protein source (such as coconut meal), our studies in Sri Lanka shows that cassava leaf meal can be included up to 40% level in balanced grower-finisher swine diets. However, as a replacement for soyabean meal, you cannot include more than 10% level unless the diets are supplemented with additional amino acid sources (especially containing methionine) and energy.

Just to add few words on digestible energy in cassava leaf meal, our work in Sri Lanka (Ravindran, V. 1992. J. National Science Council of Sri Lanka, 20: 91-98) indicates it has only 2130 Kcal DE/kg (as against 3160 Kcal/kg

for soyabean meal). This is again largely due its high fibre content.

There is general agreement nowadays that hydrocyanic acid is not a problem in properly processed cassava leaves. The major limitations are: (1) high fibre, (2) the resultant bulkiness, (3) low available energy (and energy dilution in the diets), and (4) low available amino acids, especially methionine. If these limitations can be considered and manipulated using judicious processing/feeding practices (ex: wet feeding, leaf silage) and local feed resources (ex: energy-rich feeds like molasses and cassava roots, cheap protein feeds like fish waste or fish silage), then perhaps cassava leaf meal can be economically and effectively utilized in tropical swine production systems. I am sure that some groups especially from South/Central America are looking at these possibilities.

4. Finally, in these studies, evaluation of the economics of cassava leaf production should be an integral component. The question facing the producer will be whether to (a) produce leaves as a by-product at root harvest (in which case the leaf product quality will be lower), or (b) produce leaves and roots (in which case the optimum time and number of leaf harvests will have to be carefully worked out without detrimental effects of root yields; this will vary very much depending on the cultivar, environment and agronomic conditions), or produce only cassava leaves (in which case, studies are needed to evaluate suitable agronomic practices to obtain high yields of forage with better nutritive value).

5. I will be glad to forward copies of the following reviews on cassava leaves to anyone interested (velmurug@camden.usyd.edu.au).

Ravindran, V. 1990. Cassava leaf meal. In: Nontraditional Feed Resources for Use in Swine Production (P.A.Thacker & R.N.Kirkwood, eds), Butterworths, Stoneham, USA. pp. 91-101.

Ravindran, V. 1993. Cassava leaves as animal feed: potential and limitations. J.Sci.Food Agric. 61: 141-150

V.Ravindran, Dept of Animal Science, The University of Sydney, Camden, NSW 2570, Australia.

From P. Osuji <ilri-debre-zeit@cgnet.com>

Comments on Denis Bastianelli's request on cassava leaves (more detailed information)

As the following Workshop Proceedings [Barry Nestel and Michael Graham (eds) (1977) Cassava as Animal feed: Proceedings of a workshop held at the University of Guelph, 18-20 April 1977. Ottawa, IDRC, 1977. 147p.] previously mentioned might be difficult to get (hopefully copies might still be obtained from IDRC), you will find below a summary which I got quickly and also a selected list of more accessible references selected from the same Proceedings. Most of this material has been drawn from one of the papers in Cassava as Animal Feed - Improving the Quality of Cassava Root and Leaf Product Technology by Z. Muller.

Paschal Osuji, ILRI

The use of Cassava leaves in feeding Pigs and Poultry:

Cassava leaves are a good source of protein; the protein level being much higher than that of tropical legumes. The yield of leaves is similar to that of roots (about 10 t/ha) but by close planting and nitrogen fertilization it is possible to obtain a much higher level of vegetative growth (40 t/ha or more). The aerial part should not be harvested later than 4-5 months after planting otherwise the development of the root is seriously affected. Limited quantities of leaves can be harvested at any time during the vegetative stage but always at the expense of lower root yields.

Apart from their high protein content and relatively low level of crude fibre, the leaves are very rich in ether extract, which can be attributed to high levels of chlorophyll and xanthophylls (Table 1). The content of calcium and phosphorus is also relatively high.

Because of the architecture of the plant, sun drying of leaves is quite easy and they can be dried within a few hours on sunny days. Dry leaves are preserved either in the form of leaf meal or pellets. Pelleting in the absence of steam inevitably results in some Maillard products and mild damage to the protein, which exhibits lower solubility. This is

beneficial to ruminants but not to monogastric animals; therefore, leaf meal is more suitable for pig and poultry diets; pellets are more suitable for ruminants.

Table 1: Chemical analyses (% dry matter) of leaves collected in Thailand during the wet and dry seasons and in different development stages (in weeks) (Holm 1971 cited by Gohl 1975).

SEASON	WET			DRY		
WEEKS	4	6	8	4	6	8
(cm)	70	100	135	50	60	65
Dry matter	15.3	14.5	16.1	17.8	16.2	18.5
Crude protein	24.8	22.8	24.1	25.8	29.0	25.4
Ether extract	5.2	6.2	5.0	5.6	6.2	7.0
Crude fibre	18.3	22.8	26.0	15.2	16.7	18.4
NFE	43.2	40.6	39.9	45.0	39.5	40.6
Ash	8.5	7.6	8.0	8.4	8.6	8.6
Ca	0.98	1.03	0.99	1.18	1.17	1.41
P	0.52	0.55	0.56	0.73	0.62	0.59

Until very recently the agronomic aspects of producing cassava foliage for animal feed were virtually ignored. Recent work has indicated that there are distinct possibilities in treating cassava as two distinct crops with the

roots rich in energy and the foliage rich in protein, pigments, minerals and vitamins. It also appears that the same plant can be used to produce several cuttings of leaves prior to harvesting, which would naturally result in a reduced yield of roots.

With respect to the feeding of cassava meal to pigs, there has been a rather limited amount of work done. Mahendranathan (1971) fed fresh cassava leaves, containing 250-300 ppm HCN (dry basis), to pigs from 8 to 34 weeks of age. He reported that his pigs consumed 1.4-2.3 kg of fresh cassava leaves daily and that there were no clinical symptoms of HCN poisoning. Also, pigs receiving 75 % normal levels of basal feed with ad libitum intake of cassava leaves gained as well as those receiving 100% levels, and both groups were significantly superior to a third group that received a 50% leaf basal diet. The efficiency of feed conversion was, however, decreased with decreasing basal feed allowance. The pigs on a 50% basal diet gained most economically. In a short-term study, Lee and Hutagalung (1972) fed piglets, averaging 13.6 kg body weight, diets containing 0, 10, or 20% cassava leaf meal for 4 weeks. They demonstrated that as the leaf meal content of the diets increased, feed intake, daily gain, and feed efficiency were significantly decreased. Methionine at a level of 0.20% significantly improved performance with the 20% treatment; whereas, 0.15% thio-sulfate supplementation did not. In their subsequent 6-week experiment with a heavier pig (30.9 kg), they demonstrated that addition of palm oil, molasses, and methionine to a 20% cassava leaf meal diet significantly improved performance compared with those supplemented with molasses or palm oil alone or palm oil with methionine. However, pigs on the basal diet performed significantly better than the rest. There were no clinical symptoms of HCN toxicity in these trials.

Ravindran's comments should complement the above.

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From Rena Perez <71055.111@compuserve.com>

Comments related to the potential of cassava leaves for feeding animals

Our experience in the Cuban cane coops is that upon harvesting cassava (for the tubers) only a few leaves remain attached to the stalk, therefore, the strategy most often employed is to chop the stalk and attached leaves as a feedstuff for ruminants, and not separate the leaves for swine.

Perhaps, Dr. Ravindran could comment with respect to the relative production of leaves and stalk, at root harvest. Practical experience suggests that there is more stalk than leaf, which might throw the balance in favor of using this feed resource for ruminants. But then, there are cassava producers that only have pigs!

Rena Perez

From: Velmurugu Ravindran <velmurug@camden.usyd.edu.au>

Comments in response to Rena Perez' comments on cassava leaf production

Rena Perez was correct to point out that cassava leaves are of little value as a swine feed when they are obtained at root harvest - not only the yield will be low, but also there will be less protein and more fibre. We often see only few leaves remaining at the harvest time, but this varies with the cultivar used. In some cultivars, you see reasonable quantity of leaves still remaining. In a study where we examined the relative proportion of various components of 12 cultivars at root harvest (on a fresh weight basis), the following range of values was observed: 5-14 % of the plant is leaves (leaf + petiole), 5-8 % tender stem, 30-40 % stem and the balance roots.

However, it is possible to harvest cassava leaves during growing season without greatly reducing root yields. In a Sri Lankan study (see Table 1), we were able to harvest about 6.8 t DM/ha by defoliating once during a 7-month growing season and we still obtain within 85% of normal yields of roots. In another related study conducted by Dahniya et al. (1981. Experimental Agriculture, 17: 91-96) in West Africa, it was recommended that a harvest frequency of 2-3 months, starting from 4 months into the growing season, will give best all-round yields of roots and leaves in 12-month cultivars. However, it is very important that differences among cultivars (in their tolerance to defoliation) and agronomic practices etc. must be taken into account before making any recommendation under a given situation.

TABLE. Effect of leaf harvesting (by pruning) during the growing season on various root and leaf production attributes of cassava

	No. of leaf harvests*		
	A	B	C
Fresh root yield, t/ha	13.9a	12.0b	6.1c
No of roots/plant	5.49a	5.52a	3.90b
No of marketable			

roots/plant	3.68a	3.39a	0.90b
Leaf DM yield, t/ha	4.64c	6.75b	7.63a
Leaf CP content, %	20.4c	23.3b	27.0a

*** No. of leaf harvests:**

A: only at root maturity at 7 months;

B: leaf harvests at 3 months and root maturity;

C: leaf harvests at 3 and 5 months, and root maturity.

(Data from Ravindran, V. & Rajaguru, ASB. 1988. Effect of stem pruning on cassava root yield and leaf growth. Sri Lankan Journal of Agricultural Science, 25: 32-37).

Comments on: Integrated animal production in the oil palm plantation by S. Jalaludin

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

Comments on Integration of Animal Production in Coconut or Oil-Palm Plantations (Reynolds and Jalaludin's papers)

The papers submitted by Reynolds and Jalaludin on the integration of animal production in coconut and oil palm plantation systems, are good examples illustrating the benefits of the combination of fruit woody perennials with pastures and grazing ruminants, but also of the complexity of the interactions occurring in such systems, which needs a multi- and/or interdisciplinary approach to be appropriately studied, as well as to modify the so-called "standard" research methodologies. For example, to evaluate pasture germplasm for pastoral systems, emphasis is put on attributes such as adaptation to biotic, soil and climate restrictions, forage yield, quality, and persistence under grazing, among others. As in silvopastoral systems there is at least one additional stratum of woody perennials, the evaluation of pasture germplasm to be introduced in such systems should consider their tolerance to potential interferences made by woody perennials (e.g., light transmission, nutrient and water competition, allelopathy, etc.); but some of these interferences may also function on the other direction (positive or detrimental effects of pastures on the woody perennials).

In both papers "nutrient cycling" is briefly discussed, but stressing the role of animals, and mostly with reference to the pasture understorey which is grazed and eventually partially returned through animal excreta. I wonder if the amount and quality (potential degradability) of the litter fall from those palms, and/or of the detached roots is not important (or has not been measured). Any way, if the litter coming from these palms is poor in nitrogen, it is expected that animal excreta will have a synergistic effect on organic matter mineralization.

Let me contribute with some information regarding pasture production and litter fall nutrient cycling in two silvopastoral systems studied by CATIE in Costa Rica, which may give an idea of the magnitude of these interactions with other woody perennials. Bronstein (1984) associated African stargrass (*Cynodon nlemfuensis*) to either a timber (*Alnus acuminata*) or a foliage/fuelwood legume tree (*Erythrina poeppigiana*), the latter being pruned every 6 months. In these systems the amount of N, P and K cycled through fallen litter were 64.3, 6.2 and 29.3; and 185.6, 12.2 and 64.1 kg/ha/year, for *A. acuminata* and *E. poeppigiana*, respectively. Under theses systems, grass yields were 1.5 and 3.5 times greater when associated to such trees than in monoculture, and broad-leaf weeds invasion was almost 3.0 times greater when African stargrass was grown in monoculture.

In the second study (Bustamante, 1991), seven grasses (identified as promising based on standard germplasm

evaluation techniques) and African stargrass as a control, were evaluated in monoculture or associated to *E. poeppigiana* trees, which were pruned every 6 months, but pastures were harvested every 8 weeks. In this study, six grasses (P. maximum CIAT 16061, P. maximum CIAT 16051, *B. brizantha* cv. *Marandu*, *B. brizantha* CIAT 664, *B. humidicola* CIAT 6369, and *Cynodon nlemfuensis*) yielded 16.6 to 34.2% more biomass when grown under trees than in monoculture. In these species, positive effects of nutrient cycling overcome detrimental effects of shade (40% light interference in average). Only dwarf elephant grass (*P. purpureum* cv. *Mott*) and *B. dictyoneura* CIAT 6133 showed higher yields (10.7 and 11.4 %) in monoculture. As indicated by other authors (Wilson and Wong, 1982; Norton et al, 1991), in both studies, greater CP contents were observed when pastures were grown under trees, but no consistent effects were observed for IVDMD.

Finally, I would like to say that most of the future work needs identified by Reynolds for animal production/coconut plantation systems, also apply for other types of silvopastoral systems including timber or fuelwood trees, but I would add some modelling efforts, considering few trees as representative of the diversity of canopies and/or purposes of woody perennials, as well as pasture components and growth habits. These type of studies not only require strong collaborative work among pasture agronomists, foresters, animal nutritionists, soil scientists and economists, but also North-South cooperation.

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

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From Chin Fook Yuen <chin@jph.gov.my>

Comments on feed resources from large scale plantations

The rubber and oilpalm plantations in Malaysia cover an area of 4 million hectares or more, providing a large quantity of forage dry matter, protein and energy in the form of the ground or undergrowth vegetation. In the early years of the trees, the ground vegetation presents a diverse collection of plants for livestock (a survey by Chen et al. 1974 found 60 different species) consisting of sown legume cover crops (normally *Centrosema pubescens,*

Pueraria javanica, and _Calapogonium mucunoides_) and naturally growing weed grasses, broadleaves and ferns. The feeding value of some areas of ground vegetation is comparable or even better than that of improved grasses cultivated in open pastures locally. Lane and Mustapha, 1983; Chen, 1990 and Chin, 1991 presented data to support this. The crude protein (CP) content of grasses under the plantation ranges from 8% to 17%, broadleaves weeds from 13% to 22% while that of sown legumes ranges from 15% to 18%. Higher Metabolisable Energy (ME) levels can also be obtained from this `mixed pasture' under the trees.

Sustainable forage production as the tree crop matures (6 -7 years in the case of both rubber and oilpalm) has been the major concern in this tree crop/livestock integration system. The closing canopies due to trees maturing limits the amount of sunlight penetrating to the ground, to as low as below 10% of the light. Standing biomass can decline from 2000 kg/ha during the first 3 years to less than 1000 kg/ha by the 7th year. However, this fact, along with a consequential need for a lower stocking density under mature trees, is already well accepted and is an important consideration incorporated into the management system by livestock integrators. These integrators even graze beef cattle at a stocking density of 1 animal to 4 hectares in mature areas, successfully and viably. Besides, as trees mature, there is a significant change in botanical composition of the sward which can be and is now fully taken advantage of. In place of sown legume species, more shade resistant broadleaved weed species (such as the highly valuable Asystasia intrusa and Mikania micrantha, both of which can provide very good CP value of 20% on dry matter basis even at 8 - 10 weeks regrowth) and grasses (such as _Paspalum conjugatum_) thrive. A combination of _Asystasia_ and _Paspalum_ makes excellent pasture and, with a proper interval between grazings of 8 -10 weeks regrowth, the forage yield can support good livestock production, without fear of overgrazing. One beef project rearing 400 head of the local Kedah Kelantan (KK), KK crosses and Droughtmasters, stocked at a density of 1 animal unit to 4 hectares, recorded good animal daily liveweight gains of 0.6 - 1.2 kg.

Thus the long term sustainability of this forage resource under plantation trees is successfully maintained through a well coordinated livestock-cum-plantation management package of proper grazing practice (through well-timed controlled rotational grazing using cheap single wire electric fencing) followed by removal of inedible shrub species (such as _Chromolaena odoratum, Clidemia hirta, Hedyotis_ and _Lophatherum_ spp) through selective spot spraying. The latter represents a further aspect of chemical weed control necessary for plantation management but this too

can be stopped or reduced once the *Asystasia* based pasture is established under the trees. Using this technique, livestock integrators have now successfully `guided' the evolvement of such *Asystasia* pasture under mature trees of even 18 years of age.

Is the system sustainable (in terms of environmental, economic, market and social indicators)? Firstly, the integration is environmentally friendly as it cuts down on chemical weed control in plantations with the introduction of the grazing animals. Less usage of chemical herbicide means less exposure of humans, plants and other living things to these harmful chemicals. The adoption of proper grazing practice prevents overgrazing of the ground vegetation which can lead to soil and environmental degradation, an earlier fear of plantation management. There is a useful contribution of organic matter to the soil by grazing animals. There is also no additional need for chemical fertilisers for the forage resource. Economic gains and income generated from livestock production, and the savings in chemical weed control cost make the system sustainable in the long term. Marketing of beef animals is not going to be a problem for a long time as the country is only partly self sufficient in beef. Socially, small farmer-integrators in land schemes are learning the benefit of pooling their `minds' and resources to work together and to enable a more efficient advisory and extension service from government agents to reach them.

Chin Fook Yuen, Dept. of Veterinary Services Malaysia

From Steve Reynolds < Stephen.Reynolds@fao.org >

Comments on forage production in tree plantations

I have read with interest the paper from Dr. Jalaludin on "Integrated Animal Production in the Oil Palm Plantation"and also the comments from Dr. Chin Fook Yuen.

One of the key issues is the reduction in forage production as the oil palm canopy closes with age. Dr. Chin Fook Yuen notes that standing biomass can decline from 2000 kg/ha during the first three years to less than 1000 kg/ha by the 7th year. He further indicates that this fact "along with a consequential need for a lower stocking density

under mature trees is already well accepted and is an important consideration incorporated into the management system"....This is one approach yet Dr. Jalaludin mentions another "forage production in the inter-rows can be substantially increased even under mature palms provided the planting density is reduced". The greater light penetration results in increased forage production. This is a subject which has been addressed where forage production is integrated with various tree crops (rubber, oil palm, coconut, radiata pine etc.) and it is one that I have raised in a paper to be presented later in this electronic conference. I wonder if Drs Jalaludin or Chin Fook Yuen or other colleagues from Malaysia could address this further either now or later when my paper is circulated. I know that there is ongoing research in MARDI and the Rubber Research Institute of Malaysia to study the influence of wider oil palm spacing and hedgerow planting of rubber both on forage production and the tree crop yield. Some of this work has already been presented at workshops and in published papers but there may be up-to-date findings which could be discussed or an overview on the general information coming out of some of these trials may be useful at this stage.

Steve Reynolds AGPC e-mail < Stephen.Reynolds@fao.org >

From Reg Preston <101703.3245@compuserve.com>

Comments on shade effects of trees

A point not mentioned so far concerning grazing under tree crops is the effect of shade on nutritive value. Maybe Steve Reynolds will discuss this issue when we have his paper later in the conference. He mentions it in his book.

As I understand it, the effect of shade on grasses is to increase the amount of the N in non-protein form and to decrease the concentration of soluble carbohydrates. Together these two factors represent a decline in nutritive value.

Can anyone comment on this issue and indicate if there are specific crops which are shade tolerant and which behave differently?

Reg Preston

From Steve Reynolds <Stephen.Reynolds@fao.org>

Comments on the effect of shade on the nutritive value of forage

With reference to Reg. Preston's point about the effect of shade on the nutritive value of forages under tree crops I attach the relevant pages from "Pasture-Cattle-Coconut Systems" (without figures or references) as this subject is not covered in my paper! There is evidence that low light intensities can adversely affect the nutritive value but research so far has produced mixed results. Perhaps Max Shelton or Dr. Norton at the University of Queensland can comment especially as there was ongoing work at the time of the paper presented by Norton et al. to the Workshop in Bali in 1990 which may not have been reported on elsewhere!

Steve Reynolds, AGPC, FAO

From Chapter 2 of Pasture-Cattle-Coconut Systems (FAO RAPA Pub.1995/7 pages 65-68)

2.5 Nutritive value of shaded pastures

There is evidence that low light intensities may adversely affect the nutritive value of forage species (Shelton *et al.*, 1987). Deinum and Dirven (1974) reviewed the effects of temperature and light intensity on forage quality. Wilson (1982) examined light as one of the environmental and nutritional factors affecting herbage quality and summarised the effects of shade on nutritive quality as:

i) a lowering of plant soluble carbohydrate level with, usually, an accompanying increase in cell wall content (Deinum, 1966, 1984; Hight et al., 1968; Masuda, 1977; Myhr and Saebo, 1969; Samarakoon, 1987; Wilson and

Wong, 1982);

ii) higher silica content and lignification (Deinum and Dirven, 1972);

iii) lower cell wall digestibility (Garza et al., 1965; Wilson and Wong, 1982; Wong, 1978; Deinum, 1984);

iv) a decrease in the proportion of readily digested mesophyll tissue relative to the less digestible epidermis (Chabot and Chabot, 1977; Wilkinson and Beard, 1975a; Wilson, 1984);

v) accentuated stem elongation and reduced tillering;

vi) an increase in tissue percentage moisture content which may reduce herbage intake by animals; and

vii) crude protein may sometimes actually be higher in shaded plants.

The effect of light level on the dry matter digestibility of green panic (*Panicum maximum* var. *trichoglume*) is reported by Wilson, 1982. However, in the same experiment Wong found no effect of shade on the dry matter digestibility of the legume Siratro (*Macroptilium atropurpureum*). Navarro-Chavira and McKersie (1983) determined the effect of maturity and irradiance on the nutritive value of guinea grass and Wilson and Wong (1982) and Wong and Wilson (1980) have further studied the effect of shade on the nutritive quality of green panic and Siratro. Wong et al. (1989) carried out further studies on the effects of shade (100, 60, 34 and 18% of sunlight) on dry matter production, forage quality and mineral composition of six tropical grasses in Malaysia. Common guinea and Signal grass ranked top in DM production at all shade levels and there was no significant decline in vitro dry matter digestibility (IVDMD) of the whole plant tops for all grasses except for T grass. This finding agrees with that of Deinum (1981) but is contrary to the big reduction in IVDMD in green panic reported by Wong and Wilson (1980) in Australia. Wong et al. (1989) suggest that the lack of a consistent inverse relationship between shade and IVDMD augers well for the integration of livestock with plantation crops. In addition, it was noted that the grasses under shade had a higher nitrogen/crude protein content as already reported elsewhere by Deinum et al., 1968; Eriksen and Whitney, 1981; and Wilson and Wong, 1982. A longer cutting interval reduced IVDMD.

Recently Samarakoon *et al.* (1990a) found that the dry mater digestibility of *Axonopus compressus, Pennisetum clandestinum*, and *Stenotaphrum secundatum* grown under shade was higher than that of herbage grown in full sun, a result contrary to much of the published literature (Wilson, 1982). However, although the increase in dry matter digestibility was up to a maximum of 5 percent units, in most instances it was only of the order of 1-3 percent units.

Norton *et al.* (1991) suggest that while shading reduces the total non-structural carbohydrate of grasses, it may have variable (positive and negative) effects on cell wall content and composition, lignin and in vitro digestibility of plant dry matter (Wilson, 1991), Shelton *et al.* (1987) quote the work of Fleischer *et al.*, (1984) Henderson and Robinson (1982) and Samarakoon (1987) as examples of studies where the effect of decreasing light intensity on in vitro digestibility varied with grass species tested and temperature.

In the southeastern USA Burton et al. (1959) showed that reduced light (in a comparison from 100-28.8 percent available light) decreased the herbage yields, production of roots and rhizomes, nutrient reserves for regrowth and total available carbohydrates in the herbage of Cynodon dactylon. Most significant for animal nutrition was the reduction in total available carbohydrates in herbage, particularly when less than 50 percent sunlight reached the grass canopy. The resulting energy value of grass could limit rumen flora activity and affect animal output. Shade significantly increased the lignin content of the herbage thus decreasing digestibility. Therefore animals consuming forage produced under cloudy or shady sites could be expected to make less live weight gain (Crowder and Chedda, 1982). In an early study of the effects of reduced radiation levels on forage quality, Mayland and Grunes (1974) suggested that reduced radiation levels in Idaho, Nevada and Utah would probably result in a reduction in the amount of magnesium being made available to the grazing animal (resulting in grass tetany).

There have been few studies in the past where shaded and unshaded forages were evaluated as feed for animals, but this is an area presently receiving attention.

Hight *et al.* (1968) in New Zealand compared shaded ryegrass (*Lolium perenne*) at 22 percent light transmission with unshaded ryegrass and found that shading decreased soluble carbohydrate content by 3.7 percent units, dried forage digestibility by 0.6-3.6 percent units and voluntary feed intake by 9-15 percent. Live weight gains were

reduced by 38 percent compared to sheep fed on pasture grown in full sunlight. Norton *et al.* (1991) suggest that the shading period (of 2-3 days) was probably too short for the results to have much relevance in terms of the interpretation of the longer-term effects of shading on tropical pastures grown under plantation crops.

Samarakoon *et al.* (1990b) studied the effects of much longer periods of shade (50 percent light transmission) on the nutritive value of buffalo grass (*Stenotaphrum secundatum*) and Kikuyu grass (*Pennisetum clandestinum*) for sheep. There were no significant effects of shading on digestibility (in vivo and in vitro) or cell wall composition but there was a marked depression (28-33 percent) in feed intake of sheep given shaded Kikuyu. It was suggested that the decreased intake was associated with the increased stem content of shaded Kikuyu grass, but as this effect was found in only one of the harvests Norton *et al.*, (1991) suggest that an alternative explanation for the reduced feed intake may be decreased palatability of the feed. However, the higher yielding capacity and maintenance of nutritive quality of shaded *S. secundatum* (compared with shaded *P. clandestinum*) confirms its potential usefulness for plantation agriculture. Samarakoon *et al.* (1990b) suggest that its quality is not as poor as generally believed.

Norton *et al.* (1991) undertook further experiments to investigate the effects of shading on the voluntary feed intake and digestibility of several tropical grasses by sheep. Grasses examined were setaria (*Setaria sphacelata* cv. *Kazungula*), green panic (*Panicum maximum* var. *trichoglume* cv. *Petrie*), guinea grass (*Panicum maximum* cv. *Riversdale*), Signal grass (*Brachiaria decumbens* cv. *Basilisk*), buffalo grass (*Stenotaphrum secundatum*), bahia grass (*Paspalum notatum*) and a mixture of mat grass (*Axonopus compressus*) and sour grass (*Paspalum conjugatum*) grown in full sunlight and under shade ranging from 68 and 50 to 30 percent light transmission. While there was no significant effect of shading to 50 percent on the intake and digestibility of grass species, there were changes in chemical composition (especially an increase in N concentration of shaded herbage) and sheep given feed from shaded pastures had significantly higher concentrations of ammonia in rumen fluid than did sheep fed herbage from non-shaded pastures. Fermentation patterns in the rumen of sheep fed shaded pastures also changed with propionic acid levels increasing and acetic acid levels decreasing (consistent with the fermentation of more protein in the rumen).

It was expected in an on-going (incomplete) experiment, where grasses were subject to very low light levels (30

percent light transmission), that detrimental effects could be produced.

Perhaps as suggested by Samarakoon *et al.* (1990b) only shade-intolerant species have their quality reduced by shade, because of greatly reduced total soluble carbohydrates, greater culm elongation (increasing their comparative 'steminess)' and perhaps their greater susceptibility to fungal attack. This hypothesis needs further investigation through additional feeding trials with a greater range of species.

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

Comments on fourth paper (oil palm)

It is stated by the author that palm kernel cake has got high oil content, especially when extracted by expeller. The high oil content causes rancidity leading to reduced intake/ palatability. We experienced the same problem in the Mediterranean region with crude olive oil cake (around 10% oil). Large quantities of the by-product are available during the short rainy period and they cannot be utilised efficiently. As a result considerable part is wasted, and also creates pollution problems.

When we ensiled the crude olive oil cake, even without any other material, we managed to avoid rancidity and had a well preserved material available throughout a longer period of time, and we also had the choice to use the material at any stage of production and time period.

Are the problems mentioned above with olive cake applied to palm kernel cake?

Has the ensiling technique been used to improve storage qualities, distribution/availability of the by-product throughout the year?

Indeed, some by-products are causing toxicity problems because they are available seasonably and the animals are forced to consume large quantities, despite the fact that for a considerable part of the year there is scarcity of

feedstuffs and of by-products.

"Oil Palm Fronds" can be economically utilised after being pelleted (9 mm). This is rather strange. How a bulky (?), high moisture content (?), and of long form material that requires high transportation costs (from the field to the processing/ pelleting plant and from the processing plant to the farm), dehydration (? sun-drying) and grinding can be economically used after imposing the additional expenses associated with pelleting?

From Chin Fook Yuen <chin@jph.gov.my>

Comments on rancidity in palm kernel cake

With reference to the 4th paper and comments by the author and Miltos Hadjipanayiotou on palm kernel cake (PKC) and olive oilcake respectively, I would like to share some experience and information (unpublished data) on rancidity in PKC. This is of concern to us because, currently, Malaysia's production of about 1 million tonnes of PKC is mainly shipped to European countries as livestock feed, chiefly in the expeller pressed form. A small quantity of less than 5 % is used locally for feedlotting and supplementation purposes. Problems of rancidity have always been found with insufficiently pressed PKC which has high oil content as stated by the author of the 4th paper. Well pressed PKC of between 7 to 12 % oil content however does not seem to pose rancidity problems within the first 3-4 months after production, based on experience and work we undertook to study rancidity as measured by free fatty acids (FFA)%.

A one-week old expeller PKC averaging 11.5% ether extract content was stored for 5 to 6 months between 27.2.93 and 14.8.93. At the time of storage, FFA value was 0.7%. Within the first 2 months of storage, FFA ranged between 1.4% and 1.9%. By the third month, FFA increased to a level of 4.8%. By the end of the study, this level had reached 42.5%. Our conclusion is that the normal expeller PKC would not pose rancidity problems three to three and a half months after production before FFA level reaches 5%.

In practice, our long history of using (as well as exporting) both the solvent extracted and expeller pressed PKC has

not considered rancidity as a major problem with reliable production/supply partners, timely shipping, proper storage and timely feed-out.

I wonder if the use of FFA% is a good measure for rancidity in oilcakes or are there any better measures or indicators?

Chin Fook Yuen, Department of Veterinary Services, Malaysia

Comments on: Integration of animal production in coconut plantations by S. Reynolds

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From Francisco A. Moog <famoog@globe.com.ph>

Comments on 5th paper: animal production under coconuts

I would just like to share our results on grazing Signal grass and Humidicola under coconuts in Albay province. Our results from a trial (with support from the FAO Grassland Group through the Regional Working Group on grazing and feed resources in S.E. Asia) in a private farm (Ligao Farms Systems Dev.Inc.) indicate that we can carry 2 to 3 steers per ha with ADG of 350 g without supplementation. In our situation, this is already good because with native vegetation we get only 200 g ADG at stocking rate of one steer/ha.

While integration shows good economic benefits, I feel sad whenever I see coconut lumber transported by trucks to urban Manila - we are losing these coconuts due to encroaching industrialization and urbanization within the

coconut growing areas, particularly in Laguna, Quezon and Camarines Norte 60 to 300 km south of Manila.

Francisco A. Moog, Bureau of Animal Industry, Queson City, Manila Philippines

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

Comments on the fifth paper (integration of animal production in coconut plantations)

In the Caribbean and especially in Trinidad and Tobago animal production under coconuts has been practised for 40-50 years. In the more wet smaller islands, there has tended to be intercropping with coconuts i.e. other commercial trees - cocoa, bananas were mixed into the cultivation. Alternatively animals were tethered and grazed between the trees.

Like the other plantation crops coconut production has been negatively affected by low product prices for a long time. Further soybean oil imports and from 1986, the importation and processing of whole soybean, diseases such as "Red Ring" in Trinidad and "Lethal Yellowing" in Jamaica which killed trees of 3-8 years of age, the incidence of praedial larceny, high cost of labour, etc. meant that the crop became less attractive to produce. Further, coconut growing lands by the sea or in the drier areas of islands are also a target of alternative land use especially for the hospitality/tourism industry.

In recognition of the long-standing uneconomic price of copra, land owners especially on the larger holdings introduced cattle mainly zebu and water buffalo herds to their plantations in the 1950's and 1960's. Mainly unsuccessful effort was made at planting improved grasses. Grazing then reverted to savannah grass, Axonopus compressus, and even deteriorated to inedible bushes which had to be brush cut mechanically. Cow/calf operations were the norm and still are maintained, often small feedlots are attached. Younger weaned stock are fed concentrates and by-products.

By the 1970's it started to be felt by some that the mixed coconut/grazing cattle system was at best "in transition"

possibly to pure livestock rearing. Livestock earnings and value exceeded the coconut aspect and the balance of a sustainable system was not found. In fact, with the disease and other factors described above, and with the extractive nature of production system, replanting of plantations was neglected. Trees became aged with reduced bearing and have not been replaced. In many estates trees are now 60-80 years old and with declining yields. The newer coconut hybrids on which the industry may depend for the future are not yet in use locally.

Some smaller plantings consist of younger trees but the spacing does not appear to allow enough light for forage production. Such estates have tried cattle production and have found the cost of supplementary feeding with the reduced forage levels too high and have not continued. This has been aggravated by the livestock industry not developing as anticipated in the 1960's and 1970's and in fact we have tended to be more import dependent than having local sources of meats. On the island of Tobago some producers have persisted with improved breeding, with grazing of Digitaria species, feedlotting of young stock, followed by slaughter and packaging but have had difficulty holding market share even in the midst of a flourishing tourism industry. Animal performances, meat quality, etc. are, however, good.

In summary the future does not appear to be very bright locally and this may have to do with both non-agricultural and agricultural reasons. I am interested in the outlook in parts of the world, including areas mentioned in the paper and in some more detail of their experiences.

From Jayasuriya Noble M.C. <Jayasuri@ripo1.iaea.or.at>

Comments on Integration of animal production in coconut plantations (fifth paper)

Just a comment about pasture/grazing under coconut. There has been a very interesting study reported recently in Outlook on Agriculture (1996) Vol 25, No. 3 pages 187- 192 by Pathirana *et al.* (Bob Orskov mentioned this very briefly). The study conducted in the Southern coastal area of Sri Lanka, looked at the effect of grazing the natural herbage growing in coconut plantations on the growth and reproduction of indigenous cattle, as well as on coconut

production and soil fertility. The outcome was very interesting. Very briefly, the growth, reproduction and lactation of zebu cattle was found to be poor when no feed supplement was given. Provision of rice straw or better, rice straw plus feed supplement greatly improved cattle performance (weight gain, milk yield as well as reproduction). There was an increase in coconut production and associated with it improved soil water holding capacity of the coconut land, mainly through recycling manure. Perhaps, here is a sustainable farming system, because it is a low input production system. On the other hand one can never say; it will all depend on what scale we use to measure sustainability !. (I can provide a copy of the article if any one needs - just send me an E-mail).

Noble Jayasuriya, IAEA

Comments from S. Reynolds on Floyd Neckles' comments on the fifth paper (integration of animal production in coconut plantations).

I noted with interest your comments regarding the situation in the Caribbean and particularly in Trinidad and Tobago. This is a situation not uncommon in other parts of the world and some of your observations could equally apply to the South Pacific. The major problem has always been the shade factor which limits the range and productivity of forage species and the fact that livestock were really an after thought as plantation spacing was designed to maximize coconut yield. With the decline in copra price since the 50s growers have become more interested in the livestock part of the system whereas previously livestock were rather regarded as useful weeders! Data are available which clearly illustrate the key role of livestock in providing the majority of plantation and smallfarmer income with low copra prices and also in cases where hurricane damage has been suffered which set back copra yields for many months. Until last year a number of Pacific Islands found that with low prices it was hardly worthwhile collecting copra as the returns barely covered the labour cost. With the recent price increase exports are again climbing. Many coconut trees are now past their optimum bearing age and while replanting has been undertaken many growers are beginning to question the wisdom of replanting at the traditional spacings. Thus the mention in my paper of the need to look at systems of tree spacing with emphasis on wide inter-row areas. With the wider spacing one can have production of forages or other crops in the inter-row areas on a continuous basis

without the problem of severe light reduction (although with the coconut spacings and age of some of the trees in the Pacific this is not such a major problem). Whether the coconuts are for copra export or for local consumption this system will provide for continuing yields without undue interference with or influence on the other portions of the system. As the version of the paper which was distributed was somewhat reduced in length then this aspect may not have received sufficient emphasis.

Comments on: The potential of tapping palm trees for animal production by C. Dalibard

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From Khieu Borin <borin@forum.org.kh>

Comments on the Potential of Tapping Palm Trees for Animal Production (Sixth paper)

Do you know other examples where palm sap, syrup or sugar is used for animal feeding?

Palm sap has also been used for cattle feeding, especially for the animals used for draught power. Sap is poured over rice straw and after the juice has softened the straw, it is fed to cattle. Sometimes rice straw is put close to the stove when condensing sugar syrup and the white mass (scum) floating on the surface is collected and poured on rice straw. This also serves as feed for cattle. The other common practice by the Cambodian farmers is that after having taken the soft part of the fruits for human consumption, the rest is chopped in slices to feed to cattle. Also the mature fruits are used for animal feeding.

Is tapping a practical technology for exploiting palm trees considering the risks and the labour involved?

It is true that tapping sugar palm trees requires a lot work (13-16 hours per day including getting fire wood,

climbing, carrying juice to the stove, boiling, cleaning, etc...) but it is a valuable product which generates income for the poorest farmers and it is better than staying at home having nothing to eat. It is the tree for the poor. I mean this because I have rarely seen rich farmers climb palm trees. During the dry season, from November until June-July, sugar palm juice collection is a common activity. However there is a problem of obtaining fire wood. I have seen one region where the juice is being collected all the year around. Until today which is already close to the dry season (normally palm sap collection period) some farmers still obtained an average 5kg of sugar syrup per day. This is possible because those farmers live close to the big rice mill where they can obtain cheap fuel (rice husks) to condense the juice. Regarding the risk, there is a problem to climb trees during the rainy season because palm trees become a little slippery so the climbers are very careful in this period. And the only risky time is when the climbers stick the bamboo stairs to the palm trunk. The most important point of tapping the palm tree is that the tappers consider the work is an ART in which they can play around with the inflorescences as most of us playing or working on the computer.

Are there prospects for tapping palm trees for animal feeding in your country? Is it a profitable alternative compared to other present uses such as production of fresh juice, sugar, alcohol for human consumption?

At least 30 out of 100 families in a village collect palm sap. Considering that a family is able to collect juice from 20 trees, it will be 3,000 kg of fresh juice or equivalent alcohol per day in a village. Therefore, there are only two ways of keeping palms in production that is condensing the juice as sugar syrup or feeding it to livestock. As I have mentioned earlier, condensing juice faces a major constraint either because of the required fuel or because it is a non-profitable business. Furthermore, the cost of damaging to the environment should be considered.

I have done a study last year financed by the SAREC M.Sc course which demonstrated that feeding palm juice to pigs was more profitable than condensing sugar when fire wood needed to be purchased. 4 of the 7 farmers lost money by making sugar and the most important thing is that the highest profit from making sugar is still lower than the lowest profit from feeding pigs. The profit will be higher when the price of weaned pigs (15-25 kg) will decrease. Presently, there is a lack of sows: the belief through generations is the main cause for non-saw keeping. The other problem is the high price of protein supplement. But in the present study financed by IFS, some results

have shown that pigs like cow peas silage (aerial part) and there is no palatability problem. So this could be an alternative of protein supply which makes the livestock production more attractive and profitable. And the next study will be the impact of cow peas on soil fertility.

Khieu Borin, Integrated Sustainable Livestock based Agricultural System. DAHP, Ministry of Agriculture Forestry and Fisheries. PO Box 177, Phnom Penh, Cambodia.

From Francisco A. Moog <famoog@globe.com.ph>

Comments on tapping palm trees for animal production (Sixth paper)

I found the paper interesting. However, in most areas where palm tapping for juice is going on, it may be difficult to compete against the traditional product the juice is intended for. I tried in a small way to persuade farmers in an area where coconut juice is used to produce rum (a native alcoholic drink called "lambanog") to feed juice to pigs but nobody would like to do it even if I have to pay for the value of the rum that will be produced from the juice, as it will interfere with their operation: they have to clean daily the bamboo tube used in collecting the juice.

Right now, I am in another area where the juice is made into vinegar. This product is not as expensive as the rum and the farmer is not tapping as many numbers of trees as those in the "rum area". The farmer is now cooperating with me to supply the juice for a feeding trial and of course I have to pay for the value of the juice.

There could be a place for palm juice feeding, we just have to look for the right socio-economic setting.

Let's have the alternatives when prices of rum or vinegar, in the case of my examples, drop.

Francisco A. Moog, Bureau of Animal Industry, Queson City, Manila, Philippines

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From Khieu Borin <borin@forum.org.kh>

Comments on tapping palm trees for animal production (Sixth paper)

I think it is good that Francisco Moog is trying to look for alternative feeds for livestock production, feeding coconut sap to pigs. Maybe he will obtain good results from economic and animal performance as he would like. But the later results of the trial cannot be properly used by farmers, because farmers do give much interest on what is being done as previously mentioned. According to my experience, what is done together with farmers will always remain in their memory (bad or good). As an example the politicians in Cambodia use to go to the countryside with gifts when they have meeting with farmers, but next time when other people prepare a meeting without gifts there will be no participants.

Therefore, according to my experience I would rather first select the right farmers (they can be 2-3). I would tell these 2-3 farmers the clear objective of the trial and that they choose the rest of participants. After this, we will organize a meeting with all participants. I have done trials with sugar palm juice feeding to pigs 3-4 times, but I never provide even credit for what is available in the farm (palm juice and vegetable). This will greatly influence the impact of the results.

I am now doing other trials in other areas of the country and again I do not provide credit for palm juice and they do not even ask me for that. I hope that the participants will contribute more comments on this matter and I think this is a key point for future research and development.

Khieu Borin, Integrated Sustainable Livestock based Agricultural System. DAHP, Ministry of Agriculture Forestry and Fisheries. PO Box 177, Phnom Penh, Cambodia.

From Brian Lowry <b.lowry@dance.tap.csiro.au>

Comments on sugar palm trees

Do you know other examples where palm sap, syrup or sugar is used for animal feeding?

It might be worth mentioning that some of the starch-yielding palms may carry considerable quantities of soluble sugars in the pith. In the normal processing to obtain sago flour (disintegration of pith and sedimentation from water) this is totally lost. If however the whole pith is fed to livestock this waste would not occur. The sugar content appears to be highly variable. We published on this in : J. Sci. Food & Agric 37: 352-358 (1986); E. Wina, A.J. Evans and J.B. Lowry; "The composition of pith from the sago palms Metroxylon sagu and Arenga pinnata".

Dr Brian Lowry, Principal Research Scientist CSIRO Division of Tropical Animal Production Long Pocket Laboratories, Private Bag No. 3, Indooroopilly, Queensland 4068 phone 07-32142840 fax 07-32142882

From Frands Dolberg <frands@citechco.net>

Comments on Khieu Borin's comments on tapping palm trees for animal production

Borin writes: ***"Therefore, according to my experience I would rather first select the right farmers (they can be 2-3). I would tell these 2-3 farmers the clear objective of the trial and that they choose the rest of participants. After this, we will organize a meeting with all participants. I have done trials with sugar palm juice feeding to pigs 3-4 times, but I never provide even credit for what is available in the farm (palm juice and vegetable). This will greatly influence the impact of the results."***

I have the same experience from my own on-farm work in several countries (Bangladesh, Mauritius, China, India....). It is very much a question of attitude and confidence. If these are in place, it is quite a lot that can be done together with farmers.

Frands Dolberg

From Rena Perez (71055.111@compuserve.com)

Comments related to tapping palms

I grew up in upper NY State where my brother and myself used to tap maple trees for sap and boil it down to maple syrup, ratio of 32 to 1. At that time we used a bit to open a hole in the trunk and attach a piece of metal (combined bucket holder/funnel arrangement). However, all that has now changed, the last time I saw sap being collected, the trees reminded me of a description of INTERNET, they were all joined together with thin plastic tubing, which I was told, remained in place year round. Some time ago, when Dr. Preston was in Cuba, he mentioned the ordeal of having to climb the Borassus trees and do the cutting twice a day in order to collect the juice, I mentioned the possibility of considering applying the maple collection technology. I wonder if a similar approach has been tried on Borassus or other palms. Maybe for the palm wine producers, the INTERNET technology would make economic sense. Dr. Preston (and others!) might like to comment.

Rena Perez

From S. Bellon <bellon@avignon.inra.fr>

Comments on Khieu Borin's comments

I do support Frands Dolberg's comments on issues raised by K. Borin. I recommend him to refer to the paper Castellanet & Bellon, 1985: "Training, Research and Development in Dominica (West Indies): pig raising development in South Eastern District (a case study)", In Caribbean Farming Systems and alternatives for development (colloquium held on May 9th to 11th 1985, University of the French West Indies and Guyana). UAG/DAC Ed. (BP 810 - 97174 Pointe a Pitre Cedex-Guadeloupe). pp 157-170. K. Borin will have an example on how on-station and on-farm experiments can be associated. The paper also shows how farmers collaboration can be boosted and benefit to an iterative research (action oriented) process.

S. Bellon, INRA, France

Comments on: The sugar palm tree as the basis of integrated farming systems in Cambodia by Khieu Borin

From Rena Perez (71055.111@compuserve.com)

Comments to Dr. K. Borin

Concerning a lack of sows: why don't you use the "gilt production system" and get away from even thinking about sows. Fifty percent of a litter will be females. Breed them early, aim for second oestrus, obtain a litter, after weaning, sell or slaughter. Even though the gilt produces fewer piglets, something like half-piglet per litter, she is, statistically speaking, a better mother compared to the sow. Another important factor: a sow requires, at least, one ton of dry matter, yearly. The gilt system combines "reproduction" and "production" in the same animal.

With respect to other problems, that of insufficient energy to condense the sap to syrup in order to prevent fermentation, why not convert the sap to meat. Perhaps, I am getting back to the problem of insufficient piglets, however, by implementing correctly a gilt system you could breed the gilts in order to make coincide the fattening phase of their offspring with the period of maximum sap production. In Cuba, we are using fresh soybean forage as a protein supplement for pigs, fed before the presence of the trypsin inhibitor. Has anyone at this conference any comparative data on the nutritive value of cowpea as compared to soybean forage for swine? Dr. Borin, as you have mentioned, there are lots of interesting problems to resolve, and from the tone, sometimes, of this conference some great chemists, available!

Rena Perez, Cuba

From Khieu Borin <borin@forum.org.kh>

Comments on Rena Perez' comments (sugar palm)

I would like to thank Rena Perez for her comments on how to get enough piglets for fattening them with sugar palm juice.

The problem is not only referred to the lack of sows. There are many factors involved in this matter. It is much more related to the religious belief of our people. The belief is that before rearing sows, they should have first married any daughter or son. But rearing fattening pigs are very common and popular among the farmers. This is why it makes the

system unbalanced. However in some areas I have observed that they do rear sows. Each family rears up to 5 sows including the one without having married any son or daughter. The sow is kept until 7-8 parturitions when she is a good mother and then she is sold to the slaughter house.

The other problem is the high mortality rate of piglets from 1 day to 60-80 days. This happens due to the diseases including parasitic diseases, feed (quantity and quality), early weaning, etc. The government only supports the vaccination of the large animals (cattle and buffaloes) but not for pigs and poultry. Vaccines are not produced locally but they are imported. That is why there are problems in controlling diseases. The feed provided to pigs depends mainly on the poor quality rice bran (over 50% rice husk is included) and sometimes the quantities are insufficient. Early weaning is also a big problem. After weaning, piglets are transported far from the village to be sold. Most of them die between the first and third week after being sold to the second person. The reason could be that pigs are only dependant on milk from the sow before weaning, the stress of transport and the quick change of feed.

Rena Perez' suggestion of converting sugar palm sap to meat is really a very good one. We (myself and Dr Preston) have worked on it since 1993 (during FAO/TCP/CMB and the later SAREC projects). A good profit was made by feeding sap to pigs (for more details, please see Borin et al, 1996 "A study on the use of the sugar palm tree (Borassus flabellifer) for different purposes in Cambodia").

At present I am carrying out another trial financed by IFS to use cow peas as protein supplement with sugar palm juice based diet. But we do not intend to use fresh cow peas because farmers will grow other crop after harvesting cow peas. So until now we ensile cow peas.

Concerning Rena Perez' comments related to tapping palms, we have been looking for other ways of extracting juice from palm trees. But we are not sure that we can get juice from the trunk of Borassus flabellifer. There are other people that can collect juice with the same method as you have described. It is a good idea that we hear something from Dr Saadullah from Bangladesh. He told me about that when we met in China. Farmers also told me that it is possible to get juice from the root system by digging the soil around the trunk (1 metre deep) and putting fertilizer. Later they will get a new root system which will be used for tapping juice. They can get a much higher quantity of juice. But there are reasons why it is inconvenient to practice this system. One of them is that the palm will stop producing juice for several years.

Khieu Borin Integrated Sustainable Livestock based Agricultural System. DAHP, Ministry of Agriculture Forestry and Fisheries. PO Box 177, Phnom Penh, Cambodia.

From Rena Perez (71055.111@compuserve.com)

Palm Sap as Pig Feed (comments on Khieu Borin's comments):

Khieu Borin's beautiful comments revealing my ignorance concerning "before rearing sows, either a son or daughter must be married" have served to confirm the need to continue these electronic conferences, definitely conducive to a greater interchange with respect to the appreciation of cultural values and their affect on

agriculture. Can anyone imagine his comment in a hardcopy, scientific contribution? Thanks again to the FAO/HQ coordinators.

I thoroughly understand the reasons for the high mortality rate of piglets up to 60/80 days: parasites, early weaning, stress of transport, etc. Has Khieu Borin tried removing the sow, rather than the piglets, in order to maintain the litter as an integral entity for several days before transport. This cuts down on stress. My experience in commercial piggeries showed that by treating the litter as a "family" during post weaning, the measurement or indicator for post-weaning mortality could be reduced by some 30 percent.

Related to Khieu Borin's comments on the use of cowpea silage and sugar palm juice for pigs - some of our cane coop farmers in the eastern part of the country intend to compare a feeding system based on free-choice sugar cane juice and either fresh soybean or cowpea forage. They find that cowpeas do better and will plant a 7-row plot of cowpeas, every week. Let's compare results.

Rena Perez, Ministry of Sugar, Havana, Cuba

Comments on: The African oil palm in integrated farming systems in Colombia..... by A. Ocampo

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

Comments on Alvaro Ocampo's paper

The potential of Hair sheep in the tropics: As a researcher and active Hair sheep purebred producer (St. Croix), I agree with the observations of the Hair sheep trials, Hair sheep and N fixing trees and forage. It is an excellent

small farmer system. These sheep are the world's best recyclers, can utilize feed that nothing else will eat: banana trash, palm fronds, on and on. I have developed a system to shorten the fallow (milpa) cycle by using Hair sheep and N-Fixing trees, *Sesbania*. Using the sheep in an orchard situation provides the highest production per hectare possible with the least effort. Hair sheep systems are practical and manageable by small family farmer and the meat produced feeds people and reduces the need to hunt and deplete wildlife.

Robert H. Faust Ph.D. Agroecologist Faust Bio-Agricultural Services, Inc. P.O. Box 800, Honaunau, Hawaii 96726 U.S.A. 808-328-2083 http://www.wp.com/bioag/

From Jean S. Zoundi <zoundi@burkina.coraf.bf>

Comments on "The African oil Palm in integrated Farming Systems in Colombia"

" On the experiment on supplementation with blocks containing oil, can the effect be attributed to the extra energy (by-pass ?) or to the nitrogen? Would it be an additional effect on the Brachiaria pasture?"

I am enthusiastic about using multinutrient blocks for supplementing livestock. Results are very promising.

Considering the experimental protocol and the block composition (10% urea, 10% rice polishings, 40% molasses, 15% quick lime, 10% rice husks, 5% mineral salt, and 10% crude palm oil or solubilized fatty acids), I think that the rather high Average Daily Gains (ADG) obtained are not only due to the energy but to the cumulative effect of energy and fermentable nitrogen which boosts micro-organisms efficacy in the rumen. Proteins included in the rice bran certainly had an influence as well.

In this study, pasture quality (ADGs obtained with *Brachiaria* only, show that it refers to a good quality pasture) might not permit to clearly demonstrate the cumulative effect due to the nitrogen! Nevertheless, the hypothesis of a cumulative action is most likely to happen and could be verified with another experimental design.

In the case of diets based on poor quality feeds (Sahelian rangeland, sorghum stalks), this cumulative action (energy and nitrogen) was clearly demonstrated on farm on Djallonke sheep (Zoundi et al., 1996). In this experiment, pod powder of *Piliostigma reticulatum* (local fodder tree) was used as a source of fermentable energy and was mixed with urea (2.5% of total diet). The additional ADG related to this supplementation reached 59,09 g for some treatments. The rest of the diet was based on sorghum stalks and 20 to 30% of cotton seed cake or *Cajanus cajan* (Pigeon-pea) leaves.

It was also demonstrated that the diets including less than 30% of external inputs (not produced on the farm) were giving the best economical results (costs-benefits analysis from Amir P. and Knipscheer H.C., 1989). These conclusions show that for a category of producers, the smallholders with low capital and practising subsistence agriculture, optimizing local resources to increase milk and meat production and income is a promising alternative.

Jean S. Zoundi, Zootechnicien, Attache de Recherche INERA 03 BP 7192 Ouagadougou 03 BURKINA FASO
Tel. : (226) 34 02 69 / 70 Fax : (226) 34 02 71

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Comments on: Sugarcane for Beef and Pork Production by C. Molina et al.

From Rena Perez (71055.111@compuserve.com)

Sugarcane for Beef and Pork Production (comments on the tenth paper):

In areas where swine production does not exist for religious reasons, should we still promote the fractionation of sugarcane? What other species could be used?

In Cuba, we are setting up a duck operation based on cane juice and boiled reject soybeans. The program will involve the weekly reception of one thousand, 17-21-day old ducklings. A commercial broiler unit is being reconditioned for this program which should begin in December. There will be 7000 fattening ducks, daily, which means 7 sections "in" and 2/3 sections in "disinfection". The cane tops and pressed cane stalk will be integrated in a bovine production system similar to, and definitely promoted by, the Molina family in "El Hatico" in Colombia.

One additional comment relates to the extraordinary yield of whole sugarcane on the Molina farm, 255-480 t/ha, and in Colombia, in general, I believe some 160 t/ha. Such numbers are quite unlike average world yields, which, I believe FAO quotes as 60 t/ha of millable cane stalk or 70-72 of whole cane.

Finally, would the Molina family kindly comment as to whether they are presently pursuing this animal production system? Size of operation? And if not, what finally were the constraints?

Is information available on the yield of *Gliricidia* forage in wet/dry season (if the Valle de Cauca has a wet/dry period?) as a percent of total annual yield?

The results obtained at "El Hatico" have been widely circulated in Cuba amongst members of our cane cooperatives and sugarmill farms where they have definitely served to motivate the integral use of sugarcane for animal production.

Rena Perez, Ministry of Sugar, Havana, Cuba

From Molina family <cipav@cali.cetcol.net.co>

Answers on beef and pork production based on sugarcane (tenth paper)

1. In areas where swine production does not exist for religious reasons, should we still promote the fractionation of sugarcane? What other species could be used?

The fractionation of resources as sugarcane is useful not only for pork production. In the Colombian case, "panela" (artisanal sugar), an excellent substitute to sugar as an energy source, can be produced. In this option, the tops and the scums from the panela processing are also available for other species. The bagasse is used as an energy source for concentrating the sugarcane juice.

2. How should Gliricidia or another legume be ideally produced in this integrated system?

In integrated feeding systems based on sugarcane, the fodder trees have a major importance especially as sources of proteins. Because of the high yields from *Gliricidia* (15 tonnes of DM/ha/year) and their high level of protein (24%), this specie is an interesting alternative in order to reduce inputs from outside the farm. Trials have shown that the intake of fresh forage varies from 3 to 5% of the liveweight for adults and youngs respectively.

3. What other sources of essential amino acids needed in pigs' diet could be used in a sugarcane based system?

The pig production programme in El Hatico is recent and we are aware that it is necessary to investigate in this area but it was not our initial priorities. In Cuba, Dr. Vilda Figueroa and her group have information on this.

4. What levels of fertilizers are needed to produce those quantities of sugarcane and can they come from animal excreta?

The average level of fertilizers, mainly urea (46% N), in the Cauca valley is 300 kg/ha/year. In "El Hatico", trials of organic fertilization based on cattle and poultry manure have shown that considering the soils in this flat part of the valley, 4 tonnes/ha/year of poultry manure can replace chemical fertilization with similar productions.

It is important also to refer to the research carried out by CENICANA on varieties requiring less nitrogen, and giving a good response to 150 kg of urea/ha/year.

Answers to Rena Perez' questions:

1. Would the Molina family kindly comment as to whether they are presently pursuing this animal production system? Size of operation? And if not, what finally were the constraints?

This integrated cattle pig production system based on sugarcane is still very important in El Hatico; at the moment, there are 200 pigs and 200 heads of cattle that are fed with sugarcane tops and a part of the pressed cane stalks. Anyway, we see that the best way of using the pressed cane stalks as a source of renewable energy. This takes into account that, even if the biological results are interesting for cattle (400 to 500 grammes of gain per animal per day), the costs of the supplementation (*Gliricidia*, bran, poultry manure and blocks) are not compensated by the current value of one kg of bull calf live weight. Every time we do a technical-economic analysis of the fractionation compared to the chopped whole sugarcane only for ruminants, we clearly demonstrate the advantage of fractionation.

2. Is information available on the yield of Gliricidia forage in wet/dry season (if the Cauca valley has a wet/dry period?) as a percent of total annual yield?

The production of *Gliricidia* in the conditions of the Cauca valley in dry season is better than in the rainy season, taking into account that this plant responds very well to the light and to moderate levels of the water table. The difference of production during the dry season compared to the rainy season can reach 20%.

Family Molina, Reserva Natural El Hatico

E-mail: cipav@cali.cetcol.net.co

Comments on: Livestock in south-eastern China by G. Chan

From Carlos Sandoval Castro <bcasso@tunku.uady.mx>

Comments on Prof. Chan paper (Livestock in south-eastern China)

The description of the uses of pigs in the Chinese communities certainly reminds me of the many uses they have in Mexico as well. Probably the biogas production is not a major role for pigs in many countries, but undoubtedly they do have the role of disposing the otherwise 'unedible' garbage, meat factory, money saving 'account', weed controller and so on.

Probably the pig's role in back-yards and rural communities seems at first sight undeveloped, but, is it?

This role has been developed several times in cultures throughout the world and probably reflects an approach for integrated systems in the small communities, where not only a recycling bin for fibre is needed (ruminants, and why not, pigs?) but for an animal for recycling a 'higher quality' residues, as food residual, vegetables and so on. It is only the 'traditional "agro-industrial" view' of animal factory which has made this kind of production somewhat 'forgettable', and now we are re-discovering when looking for animals or systems to fit in our "sustainable/integrated farms"

Carlos Sandoval Castro. E-Mail: bcasso@tunku.uady.mx Faculty of Veterinary Medicine and Animal Science University of Yucatan, Mexico

Comments on: Integrated Farming Systems in the Andean Foothills in Colombia... by P. Sarria and M.E. Gomez

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From: Patricia Sarria <cipav@cali.cetcol.net.co>

Answers on questions raised on their paper "Integrated Farming Systems in the Andean Foothills in Colombia"

1. Why did they change from crushing the cane to chopped feeding?

The reasons were:

- **Change of emphasis of the enterprise to concentrate on reproduction and sale of weaners rather than fattening: it is more profitable. Fully grown pigs are able to extract juice from cane stalk and to consume the same quantity of juice.**
- **Crushing the cane requires an electrical machine and this kind of energy is expensive for the farmer.**
- **Now, farmer's sons do not live in the farm, so he needs to save work.**

2. Can the swine excreta mixed with spilled bagasse still be used for biodigesters?

No, now the biodigester in Cipres farm receives cattle manure and household waste water. Other farmers use pig excreta but they use a "trick" to collect bagasse, before it goes into the biodigester. Bagasse causes a problem in the biodigester, it makes a hard layer at the top and gas production is decreasing.

3. How much food and energy (biogas) is produced in this system?

The data are still being processed for the integral system.

4. What other test apart from soil fertility can be used to determine sustainability?

- **Quality and quantity of water from water source.**
- **Quantity of soil in the water source, specially in the rainy season.**
- **Balance of inputs and outputs in the system.**

Patricia Sarria and Maria Elena Gomez

Comments on: The Role of Feeding System Based on Cereal Residues.... in Sub-Saharan Africa by Chedly Kayouli

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

Comments on urea treatment (Kayouli's paper)

On the question as to whether urea is successfully used to upgrade straw in some areas and not in others, I would like to make a few comments based on my experience. Urea treatment of straw is a technology which like almost all technologies fits well to certain niches but not to others.

In my opinion, there are 3 important questions to initially ask to find out if urea treatment is suitable:

1. Is all straw in the area already used for feeding?

2. Is there a surplus of straw which could be used if the intake and thus the proportion of straw in the diet is increased?

3. Is urea locally produced or imported?

If the answer to question 1 is YES, then the cost of urea has to be recovered essentially through an increase in the digestible organic matter available and therefore, we must compare it with the cost of other supplements like wheat bran, rice bran or whatever high quality supplements which are available. If digestibility is increased by 10%, then 1kg of urea can produce about 2kg of DOM. As a rule, therefore, if the cost of urea is more then 2 to 3 times the cost of bran, then the economy of using it is questionable. This is the case in many countries in north Africa. There are however areas where urea is a more reliable supplement than others, such as Iran where several thousands of farmers use it.

If the answer to question 2 is YES, the possibilities for success is much greater as the cost of urea now can be carried both by an increase in digestibility and by an increased use of surplus straw. This is no doubt at least part the reason why an estimated 20 million of straw is treated annually in China using this method following an FAO project initiated in 1987. Dr Kayouli is right in pointing out that also the fertilizer value of the urine and faeces is increased which has seldom been recognized. There are of course also many other factors which may prevent uptake such as labour availability and whether the temperature in the area is high enough to ensure urea hydrolyses. The treatment also requires water which may be a constraint in some areas.

If the answer to question 3 is that urea is imported, then the use of urea for straw treatment may be incorrect to introduce as the technology then becomes very vulnerable to problems of foreign exchange.

Finally urea can also preserve wet straw so that, in rice growing area, another contribution to the cost of urea is possible. The impact of using urea can be quite complex: for 2 neighbouring farms, it may be appropriate for one but not for the other.

Dr E R Orskov Rowett Research Institute, Bucksburn Aberdeen AB2 9SB, UK
Tel: +44 1224 716614 FAX: +44 1224 716687 http://www.rri.sari.ac.uk/~xbc/ifru/

From Jayasuriya Noble M.C. <Jayasuri@ripo1.iaea.or.at>

Comments on the upgrading of crop residues

I have been reading with interest the papers and comments that are being presented at the on-going e-mail conference. They are very interesting and I am sure that we all are learning a lot from each others experience.

I would like to make a few comments, from my own experience in the area of livestock feeds and feed resources.

Considering the vast resources of crop residues and by-product feeds available in many developing countries in the world and in spite of the `Residue revolution' of the 1980's, the farmer uptake of technologies for upgrading/improved utilization of crop residues and by-product feeds has been minimal. I stand to be corrected, but to my knowledge, hardly any developing country (perhaps except in China) has adopted any of these new innovations in a reasonably large scale. Some of these technologies have been considered to be `appropriate' and `farmer friendly'. Many of them have been tested on-station, on-farm and then on pilot scale in farmers fields. But yet hardly any have been taken up by the smallholder farmers.

I think we should give some thought to this and analyze as to why the farming community in general has been reluctant to accept new technologies. In other words we are talking of sustainability of the farming methods that we are developing and promoting. As many participants have pointed out, sustainability for who, where, when etc. as well as other factors involved in the sustainability of a system need thorough understanding and reviewing. One needs to realize that a technology by itself cannot be sustainable but requires many pre-requisites. For example, I am aware of a situation in Sri Lanka where, in 1982/83, straw treatment (using urea-ammonia) was practised in a fairly large scale in a certain area of the country by smallholder dairy farmers. But the technology never sustained (to the extent that we could be proud of). As anticipated, there was an immediate increase in milk production but

what was not anticipated was the reaction of some farmers who saw little point in producing more milk as they had sufficient for their family needs and had no means of selling the surplus. The farmers were not close to a major city and there was no established milk collection network. It appeared that although the technology was appropriate from the point of view of increasing milk production, it was not in terms of existing infrastructure. The establishment of the new technology required some pre-requisites (e.g. a way of disposing the extra milk). Some might argue that there should have been a bottom-up approach, first to investigate the needs of the farmers and then to promote the activity, if it were at all required. But on the other hand this is a vicious cycle as one might also argue about the point of establishing a milk collecting network without producing the extra milk. Perhaps they must go hand in hand - quite often with the blessing of the politicians - which we have very little control of.

Here is a another example. In Africa (Malawi) through an FAO/UNDP project, we carried out a number of field trials with smallholder farmers, trying to improve body weight gain of stall-fed fattening steers, through improved utilization of crop residues and by-product feeds. In Malawi, cattle are fattened throughout the year, but stall feeding is most common during the dry period between May and November. During this period farmers fatten 2-3 animals by stall feeding maize, sorghum or millet stover and ground nut tops fed ad libitum as the basal diet (with little or no green material) and 2-3 kg of maize bran/animal per day. Under normal conditions animals grow at the rate of 500-600 g per day and they are ready for market in 6-7 months. But under the FAO/UNDP project we were able to demonstrate very clearly (with farmers' animals) that provided the animals receive ad libitum (no restrictions at all) stovers and ground nut tops and the same quantity of maize bran, live weight gains up to 1 kg/day can be achieved. This was possible simply by making sure that the animals decided their ad libitum intake and not the farmers. It was done by altering the structure of the fattening stall to enable the storage and availability to animals of stover and ground nut tops all the time so that they could select and eat. By increasing the daily rate of gain, steers were ready for market in 3-4 months allowing the farmers to fatten one more set of animals before the end of the dry period. However, a recent visit to Malawi showed that this new approach to feeding, which we thought was appropriate and did not involve any additional inputs (except that the farmers had to collect stover during a short period of time and store it rather than spread his collection as and when required), had not been taken up by the farmers to the extent that we would have liked it to happen. Where was the problem ?. It was not feed because there is always so much stover unused and left over in the fields. There was no need of extra

inputs into the system because the modification we made to the stall was very simple and affordable. Wasn't the farmer interested in extra money ?. No he was very happy to have extra income. Then, where was the problem ? I am not sure of the actual answer but perhaps there weren't enough young animals for fattening or perhaps the slaughtering company could not (or would not) handle the extra animals. Were the farmers reluctant to adapt the new approach because it left behind a large amount of stubble due to selective feeding by the animals, which the farmers had to dispose of ?.

Therefore it is clear that we ought to be aware, not only that the technique should be appropriate and acceptable but many other pre-requisites need to be satisfied before any technology could be adapted and sustainable.

Perhaps this is the forum for further discussions on `sustainability' of farming systems so that the younger generation of scientists could learn new and better approaches to the problem and not repeat the same mistakes we have made in the past.

Noble Jayasuriya IAEA, Vienna, Austria

From Frands Dolberg in Bhutan c/o <shetty.sheeba@smy.sprintrpg.ems.vsnl.net.in>

Comments on Kayouli's paper

Straw treatment has been successfully adopted in some countries and tried unsuccessfully in more.

In a quick examination of reasons for lack of success, I would list these factors, mainly based on Indian and Bangladesh experiences. However, these comments are written in Bhutan, where attempts at introduction have not been very successful either:

1. Insufficient straw at individual farm level. A macro analysis may well suggest plenty of straw, but skewed land-ownership etc., means that many farmers in fact have very little straw.

2. In India and Bangladesh - and Bhutan - farmers complain of the technology being labour demanding.

3. Inadequate training of and motivation in extension workers in systems, which are basically geared towards veterinary treatment and much less animal nutrition.

4. Too little appreciation of the importance of the small protein and energy supplement that would make the rumen exploit, the extra nutrients, treatment POTENTIALLY has made available. The result is disappointing animal response and a discouraged farmer - after all the effort. To treat or not to treat is not the only question. Equally important is correct supplementation.

5. Little appreciation and inclusion in research and extension work - and training of extension workers - of the subsequent better manure quality and crop yields that can be obtained. Kayouli's paper is the first, I have seen in support of the point. However, I am reminded of comments by Indian farmers for whom I did extension work as long back as 1968-69. They also mentioned better crop yields as positive results of better feeding and better manure.

6. In short: lack of real constraint identification and too few well conducted pilot- and on-farm trials to generate feedback on the basis of which sound extension work can be planned. Such trials must be in the villages with farmers with less emphasis on out of context govt. or large farm initial testing.

7. Finally, I like to suggest, that the conference is updated on the efforts that are going on to breed good fodder qualities into straws and stovers. I understand some work is going on in India among other places at ICRISAT (the BAIF group should know). Wageningen was involved at a point and Dr. Orskov has been.

Frands Dolberg (frands@po.ia.dk)

From: Jayasuriya Noble M.C. <Jayasuri@ripo1.iaea.or.at>

Comments on urea treatment

Bob Orskov has rightly pointed out three criteria, crucial for adoption of a new technology such as straw treatment by farmers. Without a question, straw should be readily available and in surplus, and in close proximity to the operation site. Urea should be cheap enough and not an imported commodity. In monitory terms straw should also be cheap (even better if it had no monitory value), if treatment is to be beneficial to the livestock owner.

I am aware of a number of situations where just a successful demonstration of straw treatment lead to an increase in the cash value of straw in the area. While one may argue that this would bring in additional income to the man who is producing the (crop) straw, it could be disastrous to the livestock farmer, unless of course the man who is producing it is also the one to benefit from the treatment.

In addition to this, I feel that there are many other pre-requisites that one must consider before introducing a new technology such as straw treatment to rural communities. For example, in a situation where straw treatment is to benefit small holder milk production, the technology should not only be "appropriate" and "farmer-friendly", but one may also have to ask the question, "What are the consequences of increasing milk production within that existing infrastructure ?". If there is no outlet for the extra produce, such as milk, milk products, meat, calves and even manure, the technology will die a natural death. Initially the farmer and his family may want to consume the extra produce (or use the manure in the field) but invariably he will need to sell his produce to obtain cash.

Therefore, there must be a ready market for all the produce. This, I am sure we would all agree as a very important consideration. But how many of us have in the past given enough thought to such factors?

How many of us analyzed the real market situation before talking of improving milk production by straw treatment?

Perhaps we all did consider farmer's opinion but did we look into, say, the cultural, religious and even political implications of such an operation?

There is no doubt that new technologies such as straw treatment would have beneficial effects on production. But the question is, "How sustainable are they?". This will depend on many factors, that we all need to be well aware of before taking these technologies to the farmer. I feel that our lack of understanding of these pre-requisites was a major factor that contributed to the low farmer-uptake of straw treatment (except perhaps in China) by smallholder farmers in developing countries, in spite of the so-called "crop residue revolution of the 1980's".

Noble Jayasuriya IAEA, Vienna, Austria

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

Comments on C. Kayouli's paper

In the studies in Niger, 5 kg of urea fertilizer diluted in 50 l of water were sprayed on 100 kg of crop residues. Some further questions:

1. Could Chedly Kayouli comment on the possibility of reducing the amount of water, particularly in areas/countries facing severe drought?

Why the amount of urea-N retained was greater in rice straw than millet stover (49.6 vs 35.5%)?

2. Am I right if I say that the author gives the impression to the reader that feeding urea treated roughage to ruminants will increase yields (main products and by-products) due to higher availability of draught power and soil fertility?

3. Are there experimental data supporting this? Indeed, somebody might support the view that by treating poor quality roughage with urea is not an efficient way of utilisation of scarce urea (fertilizers). In the present study, like many others, 35-50% of applied/sprayed urea-N is lost, not retained in the straw. (Is it worthwhile developing methods to trap and reuse urea-N lost as ammonia gas?). Possibly, application of this urea to a poor soil might

increase at a greater extent yields (Greater output of DM, CP, digestible nutrients per unit area) thus leading to more/better dung, better animal performance etc... Certainly, I do not support the latter, I do not have data to support it, but in case there are no data supporting the opposite, we should be reserved.

Finally, I would like to ask the author, and others working in the same field, what is the proportion of farmers feeding treated roughage, especially when a project is over, and no incentives are given to the farmers?

These should be taken as a material for further discussion, and for making us to think of future steps to be taken towards wider application of the technique.

From Michel Chenost <chenost@sancy.clermont.inra.fr>

Comments on Miltos Hadjipanayiotou's comments on Kayouli's paper on urea treatment

In the case of poor quality roughages and treatment, I cannot however remain silent. Maybe the organisers already mentioned that a book (written by Chenost and Kayouli) will be issued very soon by FAO. A lot of comments and questions that arose from Chedly Kayouli's paper have of course been dealt there in.

In particular, regarding Miltos Hadjipanayiotou's question, on urea treatment enhancing the N value of faeces, this is not only a question of practical observation but also a scientifically demonstrated fact: faecal N excretion is augmented with NH_3 (as such or via urea hydrolysis) treatment. This has already been published several times.

What is remarkable is that this fact has also been reported through small farmers' observations collected by Kayouli (e.g. in Niger, Cambodia and Laos). This shows the important impact of this scientific fact at small farm level.

Michel Chenost INRA, France

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

Comments on Hadjipanayiotou's comments on Kayouli's paper on urea treatment

I would like to make a few comments relating to Dr Hadjipanayiotou's comments on capture of urea N.

First of all if digestibility is increased, then the concentration of indigestible microbial N in the faeces will increase, as observed by Dr Kayouli and so the value of the faeces for crops is better. If there is an excess of N in the diet for microbes, it will be excreted in the urine. The question then is: Should we try to capture all the N from urea treatment and how?

It is possible for instance by adding more water to retain a bit more. It is also possible to add acid to retain more. In particular with anhydrous ammonia, it is possible to evacuate the stack and lead the evacuated air through irrigation water. This however does require airtight stacks.

If the excess N has to be passed through the animal so that microbial requirement is exceeded then as I mentioned before the animal has no choice but to excrete it in the urine. However here we have a problem. Excess urea in the blood can return to the rumen several times and be absorbed as ammonia and re synthesized to urea so that the urinary N may have been through the cycle several times. This is energetically a very expensive process. Therefore, I do not think we should try to preserve excess N in the urea treated stack if the option is to have it through the animal, unless the rest of the diet was manipulated so as to utilize the excess N.

I hope this will clarify some points raised by Dr Hadjipanayiotou.

Dr E R Orskov, Rowett Research Institute Bucksburn, Aberdeen AB21 9SB, UK
Telephone: +44 1224 71661 Fax +44 1224 716687 http://www.rri.sari.ac.uk/xbc/

From Michel Chenost <chenost@clermont.inra.fr>

Comments on Orskov's answers to Hadjipanayiotou's questions

OK, Dr Orskov is fundamentally right. But, let us do it as simple as possible:

1. Straw is improved.

2. Animals' performances are increased.

3. On top of that, the bonus is in the faeces.

Is it necessary to go any further?

Michel Chenost, INRA, France

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

Comments on Orskov's and Chenost's comments on Kayouli's paper

I have no doubt that by feeding urea treated straw will result in straw richer in N, more digestible and palatable material leading to better nutrition of the animals, production of better quality manure and of course stronger draught animals. The result of better manure and of stronger draught animals will be greater yields.

My question is whether these increases (benefits) will be greater than those obtained when this scarce urea is given to an agronomist to be utilised as fertilizer.

Is the agronomist going to produce more (products and by-products)?

What the benefit will be then for animal and of course the farmer?

Are there any comparative studies?

Can somebody provide any information based on experimental data?

Miltos Hadjipanayiotou Cyprus

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

Answer to Hadjipanayiotou's questions on Kayouli's paper

The question of whether the agronomist should use the urea as fertilizer instead of straw treatment is one that is often asked.

If urea is utilized as fertilizer, the farmer in a profit maximization exercise will use urea until the last increment is no longer giving economic responses.

If a farmer uses urea for straw treatment, it has to be economical otherwise it should not be advised and farmers will soon stop using it.

The comparison with agronomic responses to fertilizer will depend on where you are on the response curve to fertilizer. I do not think therefore the comparison is all that relevant; both processes have to be economical to be recommended.

I hope this is of help but I am not an economist!

Dr E R Orskov Rowett Research Institute, Bucksburn Aberdeen AB21 9SB, UK Telephone: +44 1224 71661 Fax: +44 1224 71668

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From Rena Perez (70155.111@compuserve.com)

Comments on usage of urea for ruminants

Now that the question about the relative economic efficiency of urea usage has been raised by M. Hadjipanayiotou, I was wondering if the issue could be further complicated by asking the participants in this conference:

Has the relative economic benefit of urea for ruminants been compared in:

1) multinutrient blocks

2) straw treatment or

3) as fertilizer?

In addition, some countries are still using a mixture of molasses and urea.

Would this merit a fourth treatment comparison?

From John Chesworth <101525.2643@CompuServe.COM>

General comments on by-products

I have been following with interest all of the papers that describe the use of by-products and treated by-products in animal nutrition. One of the purposes of gathering this type of information is to be able to use it in the planning of animal production. It seems to me that one piece of information that is generally absent in these reports is some

indication as to the biological availability of the by-product. The literature on crop production in developing countries generally details the yield of the primary crop product, e.g. the grain, but ignores the yield of by-product. In the same way, the animal production literature tends to ignore this and often creates the impression that the material is infinitely available.

In terms of the simple modelling of potential production systems, what would be most useful is a series of guidelines as to the likely ratio of crop to by-product. Farmers often have a good idea as to the yields of grain that they achieve; these could be scaled to give a 'guesstimate' of the availability of by-products.

Could anyone suggest sources of such information? If collated information of this sort is as scarce as I suspect, would it not be a good idea to arrange for a future feeds conference to concentrate on this area where crop and animal production meet?

John Chesworth

From Jayasuriya Noble M.C. <Jayasuri@ripo1.iaea.or.at>

Comments on Chesworth's general comments on availability of by-products

The estimated availability of various by-products in many developing countries (often estimated on the basis of grain:residue ratio) is given in the FAO Publication "Better utilization of crop residues and by-products in animal feeding: research guidelines 1. State of knowledge" - Proceedings of an FAO/ILCA Expert Consultation held in March 1984 in Addis, Ethiopia. The reference for the publication is FAO Animal Production and Health paper No. 50, 1985.

Noble Jayasuriya

From Chedly Kayouli c/o <ADRAI@ramilamina.adrai.mg>

Answers to Hadjipanayiotou's questions

These comments are made from the Highlands of Madagascar where I could not unfortunately follow regularly the conference for the last three weeks. Nevertheless I have obtained some comments concerning my paper "The Role of Feeding System Based on Cereal Residues in Integrated Farming Systems in Sub-sahara Africa". Some questions have been raised by Miltos Hadjipanayiotou:

***1. Is it possible to reduce the amount of water used for urea treatment, particularly in areas/countries facing severe drought*?**

The urea treatment technique is based on the transformation of the urea into ammoniac in the presence of water. The quantity of water to add to the forage is therefore a factor determining the success of the treatment. The totality of large scale research works, tests and observations have demonstrated that ureolysis is efficiently achieved when final moisture of treated forage is at least 30 per 100. We have found that the use of 30-35 litres of water is sufficient to treat 100 kg of dry straw in Sahel conditions when airtightness and compression of stored straw are satisfactory (with utilization of plastic on all sides). However:

- **In Sahelian zones, the straw and the natural forage are very dry (often more than 92 per cent DM) and the air hygrometry degree is very low which favours an intense and rapid evaporation.**
- **The moisture facilitates the compression of the mass of forage and, consequently, a better evacuation of the air and a more homogeneous ammonia distribution.**
- **As plastic is too costly, the traditional ways of storing straw is used with locally available "airtight" systems.**

Therefore, straw treatment using 50 litres of water has been recommended and it has been successfully applied by

farmers.

The Sahelian regions are not only what can be seen on the television: desert, dromedaries and thirst. There are also agricultural and irrigated zones (Niger, Senegal rivers...). Urea treatment has been undertaken where water is not a seriously limiting factor especially when straw treatment is carried out just after the harvest, in November-December, when the water is still easily available.

2. Why the amount of urea-N retained was greater in rice straw than millet stovers?

During treatment and trampling, layers of rice straw are generally better compressed than in the case of millet and sorghum stovers. Therefore the mass of treated rice straw is more compact and the ammonia gas is more trapped. It is possible to treat 85 kg of rice straw per cubic meter but only 50 to 60 kg in the case of millet stovers.

3. Am I right if I say that the author gives impression to the reader that feeding urea treated roughage to ruminants will increase yields (main products and by-products) due to higher availability of draught power and soil fertility?

There are quite many scientific and practical works on urea and ammonia gas treatments that have been undertaken during the last two decades. These studies have been mainly concentrated on nutritional aspects and effects on animals with few interest on the role of this feeding system in integrated farming systems. Several scientific works have shown the increase of nitrogen content in the faeces of animals fed with treated straw (with ammonia gas as well as with urea). However, the impact of the quality of this manure as fertilizer on crops has not been reviewed by these scientific workers often enclosed in their laboratories, as myself. But there are observations of very experienced farmers who follow up with precision their crop fields in several countries: Niger, Togo, Cambodia, Laos. Practical measures indicated in the table confirm effectively these positive effect of manure. An entirely unexpected result has been also found on fishponds. Manure and urea 46N are traditionally used by most farmers in Laos so as to fertilize fishponds and promote the production of natural fish feed (plankton and zooplankton). When manure produced from animals fed urea treated rice straw was used, many farmers observed greener fishponds with more fish feed and a rapid growth of fish. Some farmers reduced the quantity of

urea usually applied.

***4. As 35-50% of applied/sprayed urea-N is lost, is it worthwhile developing methods to trap and reuse urea-N lost as ammonia gas*?**

I perfectly respect your opinion, but I do not share your arguments and your pessimism. I think that it is not necessary to open a debate on the fixing of nitrogen as all research works have practically indicated that the rate of N fixed is in average around 30 per 100 (Demarquilly *et al.*, 1989), either with the ammonia or the urea.

However, treatment improves significantly the nutritive value of poor quality forage as cereal straw which is a very basic ruminant feed in many developing countries (as observed in many studies): dry matter digestibility is significantly increased after treatment (an average increase of 20%), the nitrogen content is more than doubled and the intake is increased by 30 to 50% at least, reducing therefore the refusal and forage squandering.

It is obvious that this technique is first aimed to improve the ruminant feeding system, but nevertheless it has indirect positive effects on the economics of crop production through improvements of draught animal power and increased availability of organic manure of better quality. Yes, application of agrochemical fertilizer can improve poor soils, however most rural farm families are too poor to purchase sufficient quantities to obtain a significant effect. On the other hand, the application of the urea on non irrigated cultures, mainly in dry zones can burn the young plants when drought occurs and urea can evaporate. Whereas, manure remains the basic remedy to poor soils, not only as a supplier of nitrogen but also of organic matter which improves the structure and the texture of soils particularly those frequently sandy in the Sahel. Therefore, instead of applying one bag of urea (50 kg) as fertilizer, it is more profitable to treat one ton of cereal straw (5%) which is sufficient to feed, as a basal ration, one pair of draught animals for three months (2 Animals x 5 kg treated straw/day) when they are in greatest need (April-May-June). Thus, production of approximately half ton dry matter of nitrogen-rich manure (assuming that half of the consumed dry matter will re-appear as faeces) and improvement of animal body conditions for an efficient work are two results highly appreciated by farmers and this strengthens the role of ruminants in the farming systems.

Concerning the last Hadjipanayiotou's question, I think that Dr Orskov has brightly responded to it.

Kayouli Chedly, Institut National Agronomique de Tunisie 43 Ave Charles Nicole, 1082 Tunis, Tunisia Tel: 002161892785; Fax: 002161799391 E Mail: 101763.2164@compuserve.com

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

Comments on straw quality

Frands Dolberg's endorsement of breeding good fodder qualities into straws and stovers is very welcome. Since 1981, research on this aspect of barley breeding has been going on at ICARDA, whose mandate area includes West Asia and North Africa. Here, farmers are slow to adopt a new variety of barley if the nutritive value or yield of its straw is lower than what they are accustomed to.

Other CGIAR international research centres taking similar approaches include ILRI and ICRISAT, collaborating on sorghum and millet breeding. Some of the ILRI-ICRISAT work is in India (Email: icrisat@cgnet.com); contact people are Ercole Zerbini (ILRI animal nutritionist), Eva Weltzien-Rattunde (plant breeder), and Merle Anders (agronomist). Other ILRI work is at the ICRISAT Sahelian Centre (Niamey, Niger); Salvador Fernandez-Rivera is the contact person (Email: s.fernandez-rivera@cgnet.com).

At ICARDA (Aleppo, Syria), because of the need to follow up large year-to-year variations in straw quality, we are only now beginning to realise the potential of the approach (see below). Our work commenced with Brian Capper's Ph.D. studies, and has been continued with the work of Euan Thomson and myself (animal nutritionists). We are increasingly collaborating with Salvatore Ceccarelli, the barley breeder at ICARDA. Michael Baum (ICARDA biotechnologist) is evaluating marker-assisted selection of barley for traits including straw quality. The Email addresses are:

t.goodchild@cgnet.com m.baum@cgnet.com

s.ceccarelli@cgnet.com e.thomson@cgnet.com

For barley straw, one may summarize ICARDA's recent findings as follows. Weight gain of sheep fed straw with or without catalytic supplementation is closely related to the voluntary intake of straw (R^2=0.85). The composition and degradability of cell wall (but not the quantity of cell contents or nitrogen) are relatively stable across years, and are genotypically correlated with voluntary intake. Given $1000, we calculate that breeders can improve voluntary intake by at least 10% a generation using Near Infrared Reflectance screening, or by at least 6% a generation using ADF, in sacco, gas production or palatability tests.

I shall not even try to list work that has been conducted in Northern countries; we ourselves have been collaborating with Hohenheim University in Germany, Reading University in England, and the Rowett Institute in Scotland.

Tony Goodchild ICARDA Aleppo Syria

From Reg Preston <thomas%preston%sarec%ifs.plants@ox.ac.uk>

Comments on Hadjipanayiotou's questions

Regarding the question of urea or manure from urea-treated straw, we are setting up the following experiment.

On each of two plots 10m^2 sown with rice (one with local variety and one with HYV) we will apply urea at rate of 140g N (300 g urea). The other two plots will receive effluent from a biodigester charged with manure from cows fed urea-treated straw (5% urea on straw DM). We assume intake of 6 kg/day of straw DM (which received 300 g urea [140gN) and that 3 kg of faeces are produced and that 50% of this is converted to methane and CO2 in the digester thus 1.5kg DM/day will appear in the effluent at a DM concentration of 2%. This effluent will contain on average 2.4% N thus the N available for application to the rice will be approximately 40g which is a recovery rate of 29%.

We will therefore compare:

- **Urea on rice plot: 300g on 10m2 divided in two applications - at planting and one month later.**
- **Effluent on rice plot: 75 litres applied at 1.5 litres daily over first 50 days (the effluent is produced daily hence must be used daily as N will be lost if stored and anyway volume is too big to store).**

The effluent treatment will receive only 30% of the N received by the urea treatment (70% of the original urea having been lost in the course of the animal feeding phase) but of course the mode of application and the form of the N will be different and will favour presumably the organic form. There will be other nutrients in the effluent but in the farmer situation the contrast is essentially urea of effluent.

We could give small amount of balanced fertilizer to the urea treatment at the beginning but local experience does not favour this.

We welcome comments and suggestions from readers of the conference.

Reg Preston plus post graduate students in Vietnam

From Michael Allen <ml.allen@auckland.ac.nz>

General comment and further note to Kayouli's comment

I am following the electronic conference with great interest. But I am concerned that animal nutritionalists are taking a similar narrow view of rural development to that taken by engineers! We need to address TOTAL sustainability. We need a SYSTEMS APPROACH. We need to consider the impact of population increase...

I have a couple of notes to add to the excellent summary provided by Chedly Kayouli in answer to Miltos Hadjipanayiotou. There is no doubt that water is essential for the efficacy of urea migration into dry forage and its subsequent breakdown to ammonia. Urease just cannot work in air! But how much water will depend upon losses to the environment.

The solubility of ammonia in water also ensures that there is a sufficient residence time for ammonia absorption and reaction to take place if there is enough water present.

What is rarely considered is the physical state of the dry forage being treated with urea solution. Because most drying grasses exhibit ptylosis, the surface absorption characteristics change as the plant material dries. In essence the plant is trying to conserve what water remains within its structure. The result is that much urea solution does not adequately wet the surface of the grass and soon drains away. Ammonia solution, in contrast, has a low surface tension and, due to its high pH, can also dissolve some of the surface gums and oils on the plant. May I suggest that small amounts of surface active agents such as detergents and soaps in the urea solution will greatly improve the capture and retention of urea solutions?

Perhaps one of the participants has some field data to support my observation.

Michael Allen University of Auckland Private Bag 92019, Auckland, New Zealand VoiceMail: (649) 3737 599 7307 Telephone: (649) 3737 999 Fax: (649) 3737 463 e-mail: ml.allen@auckland.ac.nz

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From Reg Preston <thomas%preston%sarec%ifs.plants@ox.ac.uk>

Comment on Michael Allen's comments

A good idea to add some detergent, which later into the dry season we will investigate. Just now the rice straw we are treating is still of relatively high moisture content. If we improve the efficiency of treatment then the quantity of urea could be reduced which would be very attractive.

Reg Preston in Vietnam

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

Comments on Michael Allen's comments

I would like to make some comments about the possible use of detergents as a method of wetting the straw. I used detergents some years ago to see if one could open up the waxy surface of straw to increase attachment sites for microbes. It did not work very well. I fear that including detergent may well interfere with the urease activity which is essential for the hydrolyses of urea. Anyway it is worth trying on a small scale.

E R Orskov Rowett Research Institute Bucksburn Aberdeen AB21 9SB, UK
Telephone: +44 1224 71661 Fax: +44 1224 716687 http://www.rri.sari.ac.uk/xbc/

From John Chesworth <101525.2643@CompuServe.com>

Comments on water addition and urea treatment (Fifteenth paper, from C. Kayouli)

I am a little wary about the talk of adding more water when treating forages with urea. The big disadvantage (apart from safety) of many small scale caustic soda treatments is in the amount of water that this adds and the consequent high risk of moulding in the hay. The quality of the final product can in fact be lower than that of the starting material. Urea treatment avoids this problem.

An observation of ours in Zimbabwean winter was that there were enormous diurnal movements of water. The day-night shade temperature differential is usually greater than 25 degrees - immediately underneath a layer of black polythene the change will be much greater. At night, water tended to migrate to the outside of the stack and condense on the inner surface of the polythene. In the day time, the effect of sun on black polythene heated the

outer layers, moving the water to parts of the stack that were still cold from the night. In turn, most of the stack spent some of the day at a higher than average moisture content. Even in the driest part of the stack, moisture exceeded 5%, much of which we assumed to be intimately associated with the surface layer of carbohydrates.

A possible chemical parallel is the association between stationary and support phases of a GLC column. This liquid stationary phase is still capable of dissolving the polar gas phase, giving an intimate association between ammonia and carbohydrate matrix. I suspect that the chemistry of this system is extremely complex and will yield only to heuristic treatment.

Does anyone know of any literature on the effects of changing the physical conditions of these stacks, possibly by shading them?

One practical technique that we did employ was to assume that a large diurnal mass movement of water vapour and ammonia existed and that this would treat stover that could not be reached by other solutions. Some of the chopped stover was put into very open-weave hessian sacks. These were then used as sand-bags to create an outer wall into which loose chopped stover was placed. The whole stack, sacks and all, was sealed into black polythene. After urea treatment, stover in the sacks appeared to be identical to that in the centre of the stack.

John Chesworth

Comments on: The Role of Multinutrient Blocks for Sheep Production... in Iraq by A.D. Salman

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From Jean S. Zoundi <zoundi@burkina.coraf.bf>

Comments on sixteenth paper "Role of multinutrient Blocks for sheep production..." by Dr. Ala D. Salman

I am really pleased with the topics covered by this second FAO electronic conference. They are very pertinent and well in line with scientists', extensionists and political decision makers' concerns related to the improvement of animal production.

The multinutrient block is a very interesting solution to the problem of nutritional deficiencies that animals are facing for a large part of the year and especially during the dry season.

In Burkina Faso, the blocks (molasses-urea) were tested on sheep with FAO assistance in 1987-88 and the results obtained were very conclusive. Taking into account these results, the Ministry in charge of agriculture and animal production launched a large scale campaign of production and extension of these blocks.

There are two concerns at the moment:

How to enrich the blocks?

How could these blocks be made more attractive to the producers through integrating locally available ingredients?

We are focussing our present research on looking for locally available ingredients which could be used to manufacture these blocks. These formulae will then be assessed on station and on farm on the animals. Several ingredients are available in the villages: millet and sorghum bran, legume straw, Nere powder (*Parkia biglobosa*), Pilostigma powder (*Piliostigma reticulatum*)... We are taking advantage of all these potential ingredients within our on-going research programme.

I am particularly interested in the effect of the blocks on the reproduction performances of ewes reported by Dr. Ala D. SALMAN and I would like to get more information on the experimental protocol and especially:

1. When the blocks were used? During the heat or at any time?

2. For how long this supplementation has been given?

3. How was this supplementation given: blocks offered ad libitum or during limited periods during the day?

4. Was this assessment made on farm or only on station?

Jean S. Zoundi, Zootechnicien, Attache de Recherche Institut de l'Environnement et des Recherches Agricoles (INERA), 03 BP 7192 Ouagadougou 03, BURKINA FASO Tel (226) 34.02.69/70, Fax (226) 34.02.71 E-Mail: zoundi@burkina.coraf.bf

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From Ala D. Salman c/o FAO-Iraq <FAO-IRQ@field.fao.org>

Answers to Jean Zoundi's questions on the effect of multinutrient blocks on the reproductive performance of ewes

I would like to comment on the questions raised by Dr. Zoundi on the effect of multinutrient blocks on the reproductive performance of ewes:

1. When the blocks were used? During the heat or at any time?

The blocks were used during summer time, which is the main mating season of Iraqi sheep which coincides with cereal stubble grazing.

2. For how long this supplementation has been given?

Ewes were supplemented with MB for 28 days prior to ram introduction and for 51 days post mating.

3. How was this supplementation given: blocks offered ad libitum or during limited periods during the day?

Blocks were offered at certain time during the day (evening, after the flock returned from stubble grazing).

However, blocks were offered ad libitum during this time.

4. Was this assessment made on-farm or only on-station?

These experiments were conducted on-station. But during last summer (1996), we conducted on-farm experiments on three locations in Mosul area (northern part of Iraq). The early results of these on-farm experiments are promising.

Ala D. Salman, IPA Agriculture Research Center Baghdad, Iraq. Box 39094

From Rena Perez <71055.111@compuserve.com>

Comments for Jean Zoundi on MUBs for ewes

Since mid-1996, multinutrient blocks have been used in several reproductive (Pelibuey) sheep herds (on-farm) pertaining to the Cuban sugar industry. The blocks are placed, under cover, in the night paddock or the block mixture is placed in chicken troughs which are then hung from the roof beams. The animals graze in the cane fields during the day and have access to the blocks, or the mixture, during the mid-day rest or at night. The ewes have now begun to farrow (12/96) and the farmer's comments are:

1. "used to be that only 55-60% of the ewes farrowed, now between 90-95%"

2. "this year, more ewes are dropping twins"

3. "the young ones aren't dying anymore".

To answer the four questions:

1. When the blocks were used? During the heat or at any time?

The blocks are accessible year round. The animals regulate intake. In the wet season, when the grass is green, they tend to reduce block intake. The reverse happens in the dry season.

2. For how long this supplementation has been given?

Six or seven months, since May/June of 1996.

***3. How was this supplementation given: blocks offered ad libitum or during limited periods during the day*?**

Basically at night, fodder and water must be available.

***4. Was this assessment made on farm or only on station*?**

Only on-farm.

Because our work involves the sugarmills, there is a tendency to use either molasses or combinations of molasses and filter-press mud as a substrate for the urea. However, once I visited a region in South America where both molasses and filter mud were unavailable and humus, from worms, resolved the problem.

Rena Perez

From Malcolm Knox <mknox@chiswick.anprod.CSIRO.AU>

Comments on Jean Zoundi's questions on paper 16 (The Role Of Multinutrient Blocks For Sheep Production in Integrated Cereal-Livestock Farming System...)

I too have found this to be a very interesting conference and I am happy to be able to make a small contribution to

the discussion. My field is primarily nematode parasite control in ruminant livestock but most recently through ACIAR Project 9132, I have been investigating the importance of low cost nutritional supplements in the development of parasite resistance/resilience in young sheep. Our work has employed urea-molasses blocks (UMB) for its obvious nutritional benefits as highlighted by many of the contributors to this conference.

One study in which I was involved with Peter Manueli and Faiyaz Mohammed of MAFFA, Fiji, looked at the benefits of UMB supplementation in young ewes 7 months prior to first mating through to weaning of their first lambs (16 months total). Blocks were available in small shelter sheds in the paddocks and animals could access them ad libitum. In this trial UMB supplementation almost doubled the numbers of lambs born (40 vs 24), increased the number of lambs weaned (39 vs 20) and almost doubled the total weight of lambs weaned (405kg vs 222kg) when compared to unsupplemented controls grazing low quality pasture. This nutritional treatment also substantially reduced the requirement for salvage anthelmintic treatment (treated if number of eggs per gramme of faeces over 3000) during the trial period (55 individual treatments vs 92 treatments) .

Therefore in the Fijian situation where low quality forages predominate and nematode parasites are an endemic problem UMB supplements are now a recommended part of the sheep rearing enterprise. Later trials on both sheep and goat farms have had a highly positive response from farmers due to increased productivity of their flocks. Increased adoption of UMB is assured particularly since MAFFA has introduced low technology block preparation methods through on farm field demonstration days.

Malcolm Knox, Project Coordinator, ACIAR Project 9132, CSIRO Division of Animal Production, Private Mail Bag, Armidale, NSW 2350, Australia Phone 067 761440 Fax 067 761333

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

Comments on Salman's paper on blocks

First of all I would like to congratulate Ala Salman and his team in Iraq who managed to put into practice

experience on urea block (UB) manufacturing and feeding gained within the FAO/UNDP/SYR/89/003 project and outside the region.

Indeed, UB manufacturing technology has been improved considerably in Iraq (mixer, moulding equipment etc). The type of mixer they use is more efficient than any concrete mixer, particularly when working on formulae without any molasses.

Date pulp, like molasses, is an excellent material for making good quality UB. In case this material is not abundant, it is essential to work on formulae with the minimum level of inclusion so that more UB of good quality will be produced.

In the on-farm studies UB intake was considerably higher than previously reported values. Indeed, if the intake of UB by a 40-50 kg LWT sheep is 346 and 416 g/head/day, then this is not a block, but another kind of supplement that when mixed in mash form with the other ingredients of the total daily feed allowance would most likely give similar results to UB.

Knowing that animals had access to UB after the day grazing, the importance of offering UB of good hardness and compactness for securing small and frequent meals is becoming greater. In the on-farm trials in the Mosul area (Nazah & Al-Jernaf), the use of UB did not improve performance (milk yield 342 vs 358 g/head/day, and 500 vs 362 g/head/day) compared to the control diet. Contrarily, in the on station trial UB and sunflower seed meal supplementation improved milk yield significantly (control 402, UB 888, sunflower 867 g/head/day).

Why these differences between tests/trials?

How hard and compact were the UB used?

Were the UB consumed in small and frequent meals?

From: Ala Salman c/o FAO-Iraq <FAO-IRQ@field.fao.org>

Answers to Hadjipanayiotou's questions

I would first like to say to Dr. Hadjipanayiotou that his encouragement and continuous support to the Iraqi team is highly appreciated. The Iraqi team gained a lot of experience from his work in the region and previous consultancy report to Mashreq Project (ICARDA/UNDP/AFESD. RAB.89/026).

Answering the questions raised:

1. Why these differences between test/trials?

Differences were mainly due to differences in the objectives of trials/tests in on-station and on-farm. In on-station trial, the objective was to use the block as a complementary supplement. On the other hand, the objective of on-farm trials was to set a formula for blocks according to the real need of the farmers because of the shortage of barley grain nowadays in Iraq. This is why block formulation and the outcomes were different between trials/tests mentioned.

2. How hard and compact were the UB used?

Both, the hardness and compactness were good in on-station trial whereas, hardness and compactness were medium in on-farm trial in order to increase block intake.

3. Were the UB consumed in small and frequent meals?

The block was offered after the flock returned from grazing in the evening. Blocks from then on were offered only from evening until the next morning prior to the flock moving out to grazing field.

Ala D. Salman, Ipa Agric Research Center, P.O. Box 39094, Baghdad, Iraq

Comments on: Excess feeding of stovers from sorghum and maize for small ruminants and cattle... in Africa by E.L.K. Osafo *et al.*

From Jean S. Zoundi <zoundi@burkina.coraf.bf>

Comments on seventeenth paper "Excess feeding of stovers from sorghum and maize..."

Crop residues are of primary importance for animal feeding in the tropics. Several research works carried out in Burkina Faso (Zoundi, 1994) show that the post-harvest period is similar to the rainy season (July to September, when good quality green fodder is available) in terms of Average Daily Live weight Gains. In the integrated livestock- agriculture production systems of the central plateau of Burkina Faso, the post-harvest period is generally chosen by the producers for finishing the long-term fattening of cattle and small ruminants.

The strategy of excess feeding of straw is not investigated at the moment in Burkina Faso. Nevertheless, there are many on-going research works on optimizing the use of crop residues. Sorghum and millet straws are the most commonly used.

Refusals are generally used for producing compost. In the integrated livestock-agriculture production systems, the producers have the objective of taking benefit from the organic fertilization. Because of this context, the quantitative and qualitative changes of the organic fertilization are always taken into account and carefully measured during the experiments related to animal production.

Jean S. Zoundi, Zootechnicien, Attache de Recherche Institut de l'Environnement et des Recherches Agricoles (INERA), 03 BP 7192 Ouagadougou 03, BURKINA FASO Tel (226) 34.02.69/70, Fax (226) 34.02.71 E-Mail: zoundi@burkina.coraf.bf

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Comments on: New developments in livestock systems based on crop residues in China by Guo Tingshuang and Yang Zhenhai

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From Bob Orskov <ero@rri.sari.ac.uk>

The paper by Guo Tingshuang and his colleague is of great interest to many and I therefore think that it would be useful if the authors could explain to others why it has been so successful.

No doubt the institutional support has been a great factor in the success story but no doubt there are many other factors not immediately obvious to others. For instance:

1. What is the cost of urea relative to other feeds above which it would be of no economic interest?

2. Can fluctuating prices of beef be a problem?

3. Are beef prices uniform so that farmers can be sure of a return on investment after a relatively long fattening period?

I am familiar with the work but I think it would be useful for the readers if the authors could give an explanation of their success.

E R Orskov

From Guo Tingshuang, China

Answer to Bob Orskov's comments on the paper (Eighteenth paper: New developments in livestock systems based on crop residues in China)

More details on our experience can be found in our paper delivered at the International Conference on Increasing Animal Production with Local Resources, Beijing, 1993.

The support of central government is one of the main factors of the success. After many years' efforts, we have made the top leaders believing that the use of crop residues is the only way to increase animal production with non-grain feed resources in China. From 1992 to 1996, we held four national conferences (in the name of the State Council), calling for the extension of "animal production based on crop residues". We also established 164 demonstration counties with central government's funds. In 1996, the "National Development Programme for Livestock Production Based on Crop Residues Project 1996-2000" was issued by the State Council. Therefore, our technical extension with administrative means is the most important successful factor.

With reference to Bob Orskov's questions:

1. The current price (in Chinese "Yuan" per ton) for urea and other feeds is as follows:

Urea 2,000
Soybean cake 3,080
Corn 1,370
Fish meal 5,860
Cottonseed cakes 1,400

Urea (market price) is not expensive as compared with other feeds. Its price can be even lower (1350 Yuan.ton) if urea is used for technical extension. Therefore farmers do get profit from urea-treated straw.

2. and 3. Beef prices are fluctuating in China but with less changes than for other animal products. Farmers can be sure of a return on investment after a relatively long fattening period. Because the labour cost is very low, cotton seed cakes are cheap (1,400 Yuan/ton) and the straw is even free of charge if the herd is not big and if the farmers just use their own straw.

Guo Tingshuang

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

Supplementary question on paper by Guo Tingshuang (Eighteenth paper: New developments in livestock systems based on crop residues in China)

I wish to thank Dr. Guo Tingshuang for giving us the price ratio of urea to that of other feeds which, together with the surplus and therefore cheap straw available on many small farms, helps to make the treatment economically interesting for the farmers.

One of the most impressive aspects which needs commenting upon is the ability of the Chinese yellow cattle to consume straw in large quantities as they virtually fatten on 80% treated straw diets.

I would like to ask a supplementary question relating to supplements.

In the original work you have published in 2 papers in Livestock Research for Rural Development, a mixture of wheat bran and cottonseed cake 2:1 was used at the rate of 1Kg per day and the animals had growth rates between 650 and 800g/d, which is impressive for the small cattle. In some areas or provinces, cotton seed cake is cheap and available and can be used in a high proportion. In other areas, it is not available or not cheap.

What are the present recommendations as to level and type of concentrate to be used in different regions as supplements to treated straw diets for fattening Chinese yellow cattle?

I think this will be of interest for many readers as few types of so-called improved cattle can consume and fatten on such a high proportion of straw.

Dr E R Orskov Rowett Research Institute Bucksburn, Aberdeen AB21 9SB, UK
Tel: +44 1224 716614 Fax: +44 1224 716687 http://www.rri.sari.ac.uk/xbc/

From Guo Tingshuang

Answer to Bob Orskov's supplementary question on his paper

1. The ability of Chinese yellow cattle to consume straw in large quantities has been proven by lots of Chinese farmers' practice. But there is no strict feeding test to compare such ability between yellow cattle and western cattle.

2. Originally, the supplement was a mixture of wheat bran and cottonseed cake 1:2 according to FAO experts' recommendation. Later, it was changed to 100% cottonseed cake on other FAO experts' suggestion. The performances of the two supplements are just similar. It seems that 100% cottonseed cake is a little better. Some feeding tests reported in my published papers showed that the daily gain was 504-602g when 1 kg per day supplement is fed to cattle. The daily gain did reach 650-800g.

3. Cottonseed cake or rape seed cake is available and cheap in most parts of China except northeast (very cold area) and south China (tropical area).

4. We recommend "ammoniated straw + cottonseed cake" as the basic diet for most parts of China. The quantity of supplement per day per head is 1-2,5 kg according to the market price of cottonseed cake, straw, urea and

fattened cattle.

5. Improved cattle can consume and fatten on high proportion of straw. Still, the concentrate should be a little more. Usually the market price for improved cattle is better than local yellow cattle. We still have to do some feed tests to compare the ability of consuming straw between yellow cattle and western cattle.

We will be pleased to answer any supplementary questions.

Guo Tingshuang

From George Chan <100075.3511@compuserve.com>

Additional comments on Guo Tingshuang's answer to Bob Orskov's supplementary question on his paper

The best use of cottonseed wastes is as substrate for simple mushroom growing in the backyard of the farmhouse, and then the enhanced residue can be used as livestock feed. This allows the farmer to make a good income while breaking down the lignocellulose and making the crop residues more digestible and even more palatable as a feed. This is what we are doing in our Integrated Biomass Systems in the UN University Zero Emission Research Initiative (ZERI) program, with the World Authority on Mushroom helping us.

I seize this opportunity once again to remind everybody that livestock and fishery should only be fed with crop and processing residues which are not suitable for human consumption, after enhancement with microbial processing at the grass root level. It is sheer lunacy to use produce and raw materials suitable for human consumption or value-added processing as livestock or fishery feed, when we have so many people dying of hunger and malnutrition every day around the world.

In other words, NO land should be used just to grow livestock feed, as it is needed for food production first, and whatever residue unfit for human consumption or for simple processing into useful products for profit will then be

fed to animals, birds, fish and shellfish.

For 32 years, this is what I have been doing in the field, and not just talking about it. There is also too much talk and not enough action.

George Chan

Comments on: Stubble Grazing by Sheep by T. Treacher *et al.*

From Timothy Treacher <pa1treac@uco.es>

Further comments and questions from Timothy Treacher on stubble grazing

The submission of the paper on stubble grazing by sheep was prompted by the papers by Chedly Kayouli and Ala Salman discussing supplementation in dryland farming situation.

1. There is a very large area of cereals in the Mediterranean basin and throughout Asia, which is an important feed resource for ruminants. For example, in the Mediterranean Basin from Morocco to Portugal there are 28.8 million ha of wheat and 16.8 million ha of barley. After removal of the cut straw following combine harvesting, which is increasingly common, there must be approximately 1 t DM/ha.

2. There is no indication that stubble is not fully utilised under dryland farming. However, in west Asia cereal stubble on irrigated land is very often burnt, because of the pressure to plant another crop quickly in June. Could cereal stubble, with more knowledge, be utilised more effectively?

3. The limited information on stubble quality indicates that the CP/ME ratio would be expected to limit intake and it is likely that some supplementation with nitrogen or protein would improve intake. This contrasts with the flockowners experience that body condition and oestrus activity increase after the start of stubble grazing. It is possible that the breeds in the region are more efficient in nitrogen use.

Any information or comments on this would be valuable. There is a little data in ICARDA.

4. It is important to emphasise the lack of research on grazing of cereal stubble under dryland conditions in the Mediterranean basin, north Africa and Asia regions. The Australian research in the 1970 s and 1980 s showed very low intakes of straw itself and most intake on stubble being of the green weed fraction. This clearly not the case in the "Old World" systems.

5. More information is particularly important as stubble is used in the mating period and may/does critically affect the annual performance of the flocks.

If there is some unpublished data, it would be extremely valuable to know where it is.

6. Two of the experiments reported in the paper demonstrate large responses in performance to small amounts of supplementation, when the level of utilisation of the stubble was greater than 90%. This suggests that flockowners might greatly improve annual performance by supplementing, at a low level, in summer and improving the body condition of their flocks before the winter. This could reduce the need for high levels of hand feeding in autumn and winter, which is increasingly common, at least in west Asia.

7. The rooted cereal plants have an important role in preventing or reducing wind erosion in late summer and autumn. At present high levels of utilisation by flocks results complete removal leaving the ground bare. Intakes in the final days on an area are also low.

There is need for information on an acceptable balance between utilisation, intake and soil protection to improve the integration and sustainablity of the crop and livestock systems.

Tim Treacher, Dpto. de Produccion Animal, ETSIAM, Apartado 3048, 14080 Cordoba, Spain
Tel: +34.57.218542 Fax: +34.57.218563

Comments on: Tree mixtures within integrated farming systems by Mauricio Rosales and Margaret Gill

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From Chris Wood <Chris.Wood@nri.org>

Comments on Rosales and Gill's paper

Dr Rosales refers to work done in Nepal on tree fodders. In many Nepalese farming systems a major role of livestock is to provide manure to fertilize their fields as fertilizer is considered too expensive. Farmers have a two scale quality evaluation system, the chiso-obano (obhano) scale referred to by Dr Rosales and the posilo-kam posilo scale where posilo means palatable and production-enhancing. A recent study conducted by the Natural Resources Institute, Pakhribas Agricultural Centre and the University of Wales has indicated that posilo feeds are good sources of dietary protein while the chiso-obano scale appeared to be related to dung characteristics. Obano feeds, which were considered to be palatable and voraciously consumed but sometimes caused constipation, were of low in vitro digestibility. Hence there was the unexpected finding that farmers considered tree fodders of low digestibility, which would have been expected to be of little value, to in fact be of considerable use to them. It was unclear whether this was related to dung quality or was perhaps related to the avoidance of antinutritive factors in more digestible fodders. However, an important point is that feeds must be evaluated in the context of the farming system as a whole. In this case ranking in terms of in vitro digestibility would have been highly misleading.

Dr Chris Wood Natural Resources Management Dept Natural Resources Institute (NRI) University of Greenwich

Tel 44 (0) 1233 813566 Fax 44 (0) 1233 813564

From: Chedly Kayouli and his laboratory group <101763.2164@compuserve.com>

Comments on fodder trees and the use of PEG

We have read with interest the papers of Mauricio Rosales and Margaret Gill, Ali Nefzaoui and comments from Thomas Acamovic. The subject is original and we understand that little is known about the functioning of secondary chemical compounds of fodder tree species especially in ruminant feeding. We would like to add some results and reflections about the use of PEG for condensed-tannin-rich plants from our own experience.

As shown by several researchers, PEG has an affinity for tannins and reduces their negative effect. Even though the effects of PEG on intake and digestibility of diets based on tannin-rich plants are inconsistent, several researchers showed a positive effect on nitrogen use by ruminants. In our laboratory, we supplemented Acacia cyanophylla (11-13% CP and 4-7% condensed tannin) with PEG (about 25 g /day) for feeding sheep. Results showed a positive effect of PEG on digestibility and retention of nitrogen, a higher N-NH3 and VFA concentration in the rumen and an increased concentration of total protozoa (see abstract below).

Most recent studies concerning tannins were based on chemical PEG. This alternative offers several advantages such as the control of the dose of PEG in relation to the tannin concentrations in plants and the ease of treatment (watering, spraying, in concentrate and in nutritional blocks). However, we think that it is actually difficult to develop a feeding system based on fodder trees and shrubs using PEG particularly in developing countries because it is very expensive. Furthermore some questions might be raised:

1. Is the current knowledge sufficient to take up this option?

2. Are all the natural PEG analogues identified in each species of fodder tree (class of chemical, concentration in plant, specific effects...), especially in developing countries where laboratories are under-equipped?

3. Does the positive effect of natural PEG analogues meet the eventual positive effect of the mixture (nutritional complementarity or synergistic effects)?

Use of Multi-Nutritional Blocks for the Improvement of an *Acacia cyanophylla* Lindl. -based Diet for Sheep

C. Kayouli and his laboratory group, Institut National Agronomique de Tunisie

In this paper we report results of an experiment dealing with the improvement in the quality of an *Acacia cyanophylla*-based diet using multi-nutritional blocks where energy, nitrogen, minerals and PEG are added.

Six sheep where used to test diets (double 3*3 Latin square design). All diets included 400g of oat-vetch hay, dried *Acacia cyanophylla* leaves and twigs *ad libitum* (D1) and supplemented with two types of block: D2 (10% urea, 10% molasses, 5% NaCl, 5% MVS, 5% Ca2PO4, 10% cement, 20% olives cake and 35% wheat bran) or D3 (10% PEG 4000, 10% urea, 10% molasses, 5% NaCl, 5% MVS, 5% Ca_2PO_4, 10% cement, 15% olives cake and 30% of wheat bran) *ad libitum*. Each experimental period lasted 33 days (21 days for adaptation and two 5 day periods of measurements separated with 2 days rest). Intake of Acacia and blocks was measured by difference between that offered and refused, while digestibility was measured by the total faecal collection method.

The two kinds of blocks improved significantly ($p<0.01$) the DM intake of *Acacia*. Block dry matter intake was similar for the two kinds of blocks (D2 and D3). Dry matter intake of the whole diet increased significantly ($p<0.01$) on both diets. Blocks did not affect DM and OM digestibility of the diet. Nitrogen digestibility was very low for D1 but was significantly ($P<0.01$) improved on D2 and D3. Nitrogen retention was significantly different ($P<0.01$) for the three diets. For D1, Nr was negative, while clear improvements were noted with D2 and especially when PEG was added (D3). Supplementation with block improved the nutritive value of the diet; this positive effect was most marked on D3.

In conclusion, energy, nitrogen and mineral supplies given in blocks improved the nutritive value of an *Acacia*

***cyanophylla* Lindl - based diet. A supplementary specific effect of PEG is observed for nitrogen retention and digestible crude protein.**

Diets	D1	D2	D3	SE
DM intake(g)				
Acacia	569.68b	760.42a	773.42a	29.65
Block	0	271.88a	260.89a	11.81
Diet	929.5b	1392.1a	1394.08a	12.94
Diet digestibility (%)				
DM	48.49	47.15	49.49	0.96
OM	51.75	50.24	52.4	0.95
CP	30.45c	51.26b	64.18a	1.4
Nitrogen use (g)				
Nr	-0.39c	4.11b	7.73a	0.71
Nutritive value of dietsg/LW$^{0.75}$				
DOM	25.75b	34.24a	35.75a	1.05
DCP	1.75c	6.65b	7.95a	0.312

a, b, c; Data in the same line with different superscripts differ (p<0.01)

From: Tony Goodchild (PFLP) <t.goodchild@cgnet.com>

Reply to Chedly Kayouli's comments on the use of PEG

It was good to see that Chedly Kayouli's results on *Acacia cyanophylla*, particularly the response to multinutrient block supplementation. No-one can argue with his conclusion that "energy, nitrogen and mineral . . . in blocks improved the nutritive value of an *Acacia cyanophylla* . . . based diet" even without PEG, but it would be good to know which of the nutrients he supplied had the greatest effect.

Work was reported in Australia in the 1970s for merino sheep consuming a rather similar shrub, *Acacia aneura* (mulga). Feeding supplements containing sulphate, such as Na_2SO_4, $CaSO_4$, molasses and the ash of molasses, increased the sheep's voluntary DM intake by about 40% (Hoey *et al.* 1976; see also Gartner and Niven 1978). Phosphorus supplementation increased mulga intake by 20% (McMeniman 1976).

Mulga may be lower in DM digestibility than *A. cyanophylla*, but seems to be similar in tannin and apparent nitrogen digestibility. Kayouli's 50% increase in DM intake should be seen in this light.

This E-mail conference seems to have neglected the role of minerals in improving the efficiency of animal production. Surely, if a specific micronutrient is limiting, the response to correcting the deficiency is usually enormous in comparison with the cost, and work to locate problem zones will have potential benefits for even the poorest producers.

I look forward to meeting you all again, either in TFConf3 (please!) or in person,

Tony Goodchild, ICARDA, P.O. Box 5466 Aleppo, Syria (t.goodchild@cgnet.com).

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Hoey, W.A., Norton, B.W. and Entwistle, K.W. (1976) Proceedings of the Australian Society of Animal Production 2:377-380, McMeniman,N.P. (1976) AJEAAH 16: 818-822.

From Chedly Kayouli <101763.2164@compuserve.com>

Reply to Tony Goodchild's comments on the use of PEG

Thank you for reading with interest our results concerning supplementation of *Acacia cyanophylla*. We absolutely agree with you that the role of mineral effects in improving the efficiency of animal production seems to be neglected. In our trials we added minerals through the different nutrients, cement, bicalcic phosphate, NaCl, and mineral-vitamin supplement. Minerals were not studied for their specific effect, and the most important factor that we considered for its greatest effect was PEG 4000.

We believe, as reported by Jansman (1993, Nutrition Research Reviews, 6, 209-236) that information on interaction between tannins and minerals is hardly available. The research work you referred to provides little but precious information about this aspect. It seems that tree leaves are generally very rich in calcium and poor in phosphorus, so a negative phosphorus balance is frequently shown by animals fed on tree leaves. Most studies we have seen on the interactions between minerals and tannins concerned especially phosphorus (tannins do not seem to affect phosphorus) and sulphur (because of the sulphur amino acids). The presence of high dietary tannin has been found to be responsible for a decrease in wool growth due to the reduced sulphur amino acids absorption.

In this respect, Pritchard *et al.* (1992, J., Agric, Res, 43; 1739-1746) showed that sheep fed Mulga (*Acacia aneura*) retained more N and S when supplemented with 24 g/day PEG. These results were further enhanced when a mixture of nitrogen, phosphorus and sulphur was added in conjunction with 24 g/day PEG.

A few years ago, we carried out some research (unpublished) where we studied the effect of minerals on *in vitro*

fermentation of some by-products. We hope to do the same with acacia in combination with PEG effect.

Chedly Kayouli, Institut National Agronomique de Tunisie
