# Comments on: The Role of Feeding Systems based on Cereal Residues... by Chedly Kayouli

**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/xbd*

**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, BucksburnAberdeen AB21 9SB, UK Telephone: +44 1224 71661 Fax: +44 1224 71668*
*7 http://www.rri.sari.ac.uk/xbc/*

**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*

**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*

**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*