ANNEX 3

SUMMARIES OF PAPERS PRESENTED

OPPORTUNITIES TO ENHANCE AND INTERPRET NUTRIENT FLUXES AND IMBALANCES IN ANIMAL PRODUCTION SYSTEMS BY USE OF STABLE ISOTOPES.

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The flows and transfers of nutrients within agricultural systems are complex and the presence of livestock increases the complexity. Few, if any, systems are in equilibrium with respect to nutrients inputs and outputs and all are "leaky" to some extent or other: the presence of animals inevitably increases the opportunity for inefficiency. Whilst there is still much need to enhance nutrient use in many parts of the world in order to promote crop/food production particularly in resource-poor environments, there has been considerable recent research which re-examine nutrient behaviour because of pollution effects. Understanding nutrients fluxes and budgets/balances of inputs and outputs within a system and its component parts, provides the means to assess (i) current status, (ii) extent of losses and (iii) potential options for change to reduce losses, increase nutrient use efficiency and sustain or enhance production at minimum cost. Increasingly, nutrient accounting is being used at field, farm and national scales to aid decision making and planning. To do this effectively, requires that the sources and transfers of nutrients to, from and within the system be known. The paper discusses the way in which systems and farm gate balances can be used to promote efficiency of nutrient use in relation to required production levels and to optimise (i) investment in purchased nutrients, (ii) opportunities to capitalise on internal recycling and (iii) other farming activities which influence nutrient balance, surplus and loss. A major challenge for the future will be to balance the on- and off-farm needs of supplying and utilising nutrients in order to maintain long-term sustainability of farming systems, food production and rural resources.

The paper concentrates on aspects of N in livestock systems as this provides one of the main opportunities to increase effectiveness of nutrient use in agriculture throughout the world with the aim of demonstrating some of the key areas in which there is a need for improved understanding. Methods are being developed for understanding and controlling balances and qof the processes involved. Increasingly, stable isotopes are being used to help develop this understanding. Examples are given of the way that enriched sources, and particularly natural abundance levels of N are being used to determine the way that controls over the flows of N at various physical scales within particular ecosystems are operating.

By way of example, three case studies are taken to illustrate opportunities to employ stable isotopes of N to better understand fluxes, provide improved model description and predictive capability and ultimately to improve the management and outputs from the farm The first is an intensively managed 76 ha temperate dairy system, in SW of England; the second is 2 farming systems in the highlands of E. Kenya where traditional soil fertility practices cannot be maintained with an increasing population and land scarcity, and the final case study is that of a balanced, productive and environmentally sound integrated farming system in which modest amounts of external inputs are used to supplement recycled nutrients within a semi-intensive, agriculture-aquaculture management in Asia. The particular general areas within livestock systems which require further definition to enable improved N utilisation and which can be probed by $\delta^{15}N$ studies include: impact of dietary quality on N utilisation and partitioning into excreta, the dynamics of N turnover from excreta, plant residues and soil organic matter and effects of changes in local husbandry/management practices, spatial and temporal effects of excretal return (either at grazing or after storage/application), interactions between N, other nutrients and water availability, N sources