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1. Introduction: Towards a Theory of Knowledge Production and Local Knowledge Loss

Currently knowledge is produced in great quantities and spread around the globe. The law of diminishing returns does not seem to apply to the production and dissemination of knowledge. The more is known in a society or community, the more valuable new knowledge becomes. There is not only an abundance of knowledge but also an increasing literature on the creation of new knowledge, on the sharing of knowledge and the productivity of new knowledge. So far an important aspect has been largely absent from this debate, namely the loss of knowledge.

In the context of this paper we shall limit our scope and refer to knowledge as a human resource that is used to guide social action. In this limited perspective all factual knowledge is derivable from experience but knowledge is needed to produce, share and acquire new knowledge. We shall concentrate our attention on indigenous and on local knowledge. Both terms are often used interchangeably but we distinguish between the two. Indigenenous knowledge is passed on from generation to generation and is firmly grounded in the tradition of a group, community or society. Local knowledge is acquired through learning and adoption to local conditions. Knowledge that has been brought back from studying abroad, from reading, viewing or listening to mass media or adopted through other channels has become local knowledge, as soon as it has been adopted to local social and cultural conditions and is ready to be applied locally. Local knowledge constitutes a 'milieu' within a network of social interaction (Evers 2005:63). Indigenous as well as local knowledge may be lost. The dialectics of knowledge production leads both to knowing and not-knowing. The more knowledge is produced the more we know what we don't know (Evers and Menkhoff 2005:145). Solving a research problem usually opens up new research questions and thus increases our ignorance. Another form of creating ignorance is knowledge loss. This process does not indicate that old knowledge is up-dated or replaced by new knowledge but the attrition of a stock of available and usable knowledge. In the following section we will show how knowledge loss has happened and how knowledge seapage has occurred in rural Uzbekistan. Based on empirical field research we shall be able to systematise forms of knowledge loss and discuss its consequences for rural development.

2. Knowledge Loss in Practice

What is not known is as important as that which is known. Whilst Evers and Menkhoff (2005: 145) discuss 'the growth of ignorance' in terms of a relative growth of ignorance as a corollary to a growth of knowledge, we wish to discuss here the growth of ignorance in terms of knowledge loss in Uzbekistan during and after the Soviet period. This is based on one year (in

2005) of field research in the Khorezm region, in the western periphery of Uzbekistan[1]. That is to say that indigenous knowledge has in some ways been 'lost' during the period of Soviet colonialism of Khorezm. Likewise there has been some attrition of indigenous knowledge in the post-Soviet era. This is pertinent in terms of knowledge of livestock production and post-harvest processing. In addition there is the simple, static, ignorance of new technologies and farming methods that are available in other parts of the world, yet which are not known in Uzbekistan. This is largely caused by the knowledge control approach adopted by the government of Uzbekistan. As do the role of ineffective linkages between farmers and local (i.e., Uzbek, non international) research institutes and universities, for failing to combat knowledge attrition in rural Khorezm. Whilst indigenous knowledge is dynamic, in that it is constantly evolving and changing, it is not always in the ascendancy. Instead what we show in this paper is that whilst the Soviet period introduced a considerable amount of new agricultural knowledge, which was adapted to local conditions and thus made 'local', there was also a considerable growth of real ignorance (distinct from relative ignorance, see Evers 2000) which is manifest in Khorezm today. This is not to totally discount the level of indigenous knowledge growth that has occurred in the 15 years since Independence. What is worthwhile mentioning is that a significant amount of knowledge was simply 'lost' during the Soviet period, mainly due to the collectivisation of certain agro-economic activities. With de-collectivisation and the break down of existing collectives, post-1991 this attrition of knowledge continued. This is particularly relevant for the rural economy of Uzbekistan, as this 'lost' knowledge could potentially play a large developmental role in promoting new livelihood strategies, such as through post-harvest processing.

1. Livestock Production

With collectivisation in the 1920s, livestock production was transferred from an almost purely domestic affair into a collectivised and specialised industry of the state[2]. Whilst post-WWII reforms within agricultural production allowed for limited domestic production of livestock within the household economy, large amounts of indigenous knowledge had already been lost. For instance chickens, which were allowed for much of the Soviet period yet were reared from eggs centrally and distributed to the households. The healthcare of these chickens was centrally managed, with a *kolkhoz* veterinarian being responsible for ensuring regular inoculation (Interview with whom?, 17 August, 2005). With the demise of the Soviet Union, these structures collapsed, leaving rural households without their pre-collectivisation knowledge. This is manifest in many ways, for instance the ignorance of how to treat sick chickens (Field notes, 5-6 April, 2005). This same lack of knowledge is also the case with cattle production. We conducted a survey on farmer's knowledge of cattle health and milk production in October and November of 2005, including 50 in-depth interviews with farmers. The findings of this survey confirmed the issue of knowledge loss, which was even identified by a number of respondents themselves, noting the decline in cattle rearing post-de-collectivisation[3]. The

[1] Field work was carried out in 2005-06 by Caleb Wall within the framework of the interdisciplinary project "Economic and Ecological Restructuring of Land and Water Use in the Region Khorezm (Uzbekistan)" of the Center for Development Research (ZEF).

[2] We are conscious here that pre-1920 knowledge on livestock was far from static. Rather the Russian Imperial history has bought with it considerable amounts of new knowledge and different animal breeds. Likewise the gradual shift away from nomadic and pastoral livestock production towards centralised rearing should not be seen in an historical context. Rather we are discussing a phenomenon of post-Soviet knowledge loss which is very different from these knowledge 'transitions' between different modes of production, because it was the shock event of decollectivisation that destroyed one system of knowledge whilst not fully developing the new system. This is thus a study of knowledge in dynamic transition.

[3] For instance, over 80% of respondents had cattle, sheep or both, yet only 17% of these respondents claimed to have had any formal or informal training in livestock health of foddering practices.

education level of those involved in livestock tasks, most importantly feeding and milking, was limited. Very few respondents expressed any knowledge of sanitary and hygiene rules associated with milking, the one woman who did employ a strategy for sanitation possessed this 'specialised' knowledge because of Soviet era training. Whereas two of the respondents (both men) were owners of a large number of cattle and possessed a superior level of knowledge about the anatomy and feeding requirements of cows, yet professed that they applied little of this. We were unable to fully understand why this was the case, but our suspicion is that the cause is tied up with the ceiling on entrepreneurship discussed later in this paper. Another interesting aspect of livestock knowledge is the gendered issue of knowledge transmission within the family structure. To quote directly from a research assistant:

"People learn farming mostly from family members, from their childhood taking care of cattle is one part of their life. There is no special age or time to teach farming for children, they learn farming as a one part of their daily lives. According to the survey, male children learn farming from their fathers, 18 men from the 27 male respondents learnt farming from their fathers. The other learnt farming from the everyday life practice, this could have been the absence of their father or they lived with their mother in the childhood. The female farmers learn farming both from female members of the family and the male members of family. For example, in the survey, 10 female farmers learnt farming from their mothers and 11 women learnt from their father and both from mother and father"

This male dominated knowledge transmission process, combined with the issue of knowledge loss reinforces the importance of understanding how cultural norms find their expression in knowledge sharing processes, even in cases where this knowledge is diminishing. What it also illustrates is the state of "relative ignorance" and indeed the post-1991 growth of ignorance, which has occurred in rural Uzbekistan. This is not to say that no knowledge exists, on the contrary rural Khorezm illustrates the ways in which farmers respond to challenges in creative ways. For instance how social networks are used to promote the breeding of cattle and sheep with those from other *kishlaks* (villages). Here farmers are demonstrating that they understand the risks of inbreeding (and indeed vocalised this understanding in interviews) and are acting upon this knowledge in a culturally grounded manner. That is using existing social and community linkages with other *kishlaks* to mutual benefit. This is another instance where knowledge takes a form and function which mirrors the cultural context in which it operates. Equally we should remember the political power function that knowledge plays in agriculture and realise that Soviet centralisation of production and the specialisation that this entailed were not politically neutral, rather the process served to further the centralisation of control and to reinforce central power. With the collapse in agriculture, there have been masters and large scale farmers who have been able to profit from superior knowledge (or political connections) to build businesses based on the knowledge deficit of others. Thus the knowledge loss is dynamic, it is changing and local solutions are being developed to confront the post-1991 collapse or livestock knowledge.

2. Post Harvest Processing

During the Soviet period almost all industrial processing of raw agricultural materials occurred outside of Uzbekistan and Central Asia (Spoor, 1999: 5). Cotton, wool, leather and other agricultural commodities were 'exported' to other Soviet Republics for processing, in accordance with the Soviet doctrine of division of labour[4]. This created a system of agricultural production and dependency, reminiscent of European colonialism, with uneven development and reciprocal differentiation (Wall, 2004: Ch.3; Kandiyoti, 2002a) and one that had a deleterious

[4] Interestingly, this was taken as much from descriptive work of Marx on the capitalist labour process as it was from the normative writings of the American management scientist Taylor.

effect upon indigenous knowledge in Khorezm. Without entering into the discourse on whether Soviet rule of Central Asia constituted a colonial relationship, it is worthwhile noting that the impact on the indigenous knowledge regarding commodity processing bears much in common with colonial experiences from India and elsewhere. So just as colonial India was created as a dependent, vassal, state by way of moving all processing of cotton towards England (Baran, 1957) a similar case arguably occurred in Uzbekistan. This is because the knowledge associated with how to process agricultural commodities, such as cotton and wool, was simply 'lost' or destroyed between 1917 and 1991.

Cotton prior to the Soviet period was also grown to order for Tsarist authorities and processing was centralised towards Moscow (Peachy, 2004: 3). The attempts at creating post-harvest facilities in the period after 1991 have had mixed success, whilst the industrialisation of the cotton industry remains a state priority, numerous formal and informal barriers are erected. The economic and political problems behind these barriers are the topic for another study. Rather, we focus here on a common commodity, wool. Whilst cotton is economically, ecologically and socially the most important crop in Khorezm and Uzbekistan; post-harvest processing remains slight (Kandiyoti; 2002a, 2002b). Likewise wool plays a minor role in the economy of Khorezm, yet holds considerable potential, as explored below.

Case Study: Wool Processing

We know from historical writings that there was a well developed wool industry in Khiva during the 'Kushan' period (Tolstov, 1948) and it is reasonable to assume that domestic processing occurred until the imposition of soviet rule (circa 1917-1924). However, there is little indigenous processing of wool occurring in Khorezm today. Whilst small domestic production of woollen socks and gloves does occur, this is a rather specialised activity; we were able to find only two households in the research village who were engaged in this trade[5]. Likewise, there are two carpet factories in Khorezm which process large amounts of wool, yet these operate outside of the indigenous knowledge system. Economically, wool products make up only a fraction of internal trade and are negligible in terms of exports (Ruzmetov et al., 2004: 8-10). Yet sheep rearing is quite common in Khorezm, with 16% of respondents to our rural survey (N=457?) reporting that they kept sheep[6]. Thus we attempted to explore why it is that wool is not being processed and found that knowledge loss is a significant contributing factor. For instance, one informant, the owner of over one hundred sheep and forty goats, which he grazes in the desert, is an eloquent example of how far the wool processing industry has declined. Despite having such a large flock, it is simply not economically worthwhile to sell his fleeces "I get 50 cym[7] per kilo of wool – it costs that much just to shear the wool – I am not interested" (Polvon, Interview, 13 May, 2005). Thus each year the wool is composted in the desert and goes to waste. This is an understandable reaction to problematic economic conditions and is perhaps little related to knowledge loss. However, the astounding aspect of the Polvon case study is that he is interested in making a profit from his wool and sees it as potentially valuable. Yet he admitted to be unaware how he could make a profit from this latent resource. One option involved turning the wool in ropes, with which to tether his sheep at night. Yet even for this he was going to have to consult a 'master[8]' (in this case an agricultural engineer) to access this knowledge.

[5] It is of course possible that the kishlak was exceptional or that we simply missed a form of processing, however the experiences were of a considerable level of ignorance about wool processing.

[6] An average of 5.94 sheep per household which reported having sheep, with a maximum of 25 and a minimum of one.

[7] Approximately US$ 0.05 / EUR 0.04 in 2005.

[8] An emic term from Khorezm which denotes 'mastership' in a particular realm of knowledge. For more discussion see Wall (2006).

This stands in some contrast to the Khiva carpet factory, which was established in 1972, producing wool-synthetic blended carpets for around the Soviet Union (Interviews with factory manager and head of work brigade, 7 October, 2005). Whilst there were obvious disruptions in the immediate period after 1991 and the disintegration of the Soviet Union, the factory has been able to continue production, indeed in 2001 a large investment was made in buying new German technologies (Field notes, 7 October, 2005). In discussions with the various 'brigade leaders', the heads of each manufacturing process in a form of labour organisation imported from the Soviet era, each demonstrated how they were able to apply their knowledge and adapt to new realities of operating post-1991 (Field notes, 7 October, 2005). Indeed, the investment in the German technology meant that new knowledge was acquired, and adapted to suit local conditions, reversing this trend of knowledge loss. It is worth noting that now they use much less wool in their carpets, explained both in terms of cost and in the difficulties of sourcing quality wool domestically. Given the low price for wool explored above, this disconnect may suggest that there is a crucial need for development in the wool post-harvest sector, and one that certainly involves knowledge as a central point.

As explored elsewhere in greater detail (Wall, 2006; Wall & Lamers, 2004; Kandiyoti, 2003), the state's control over the labour process (direct power) and indirect control impeding innovation, both lead to this knowledge loss and the failure of the local knowledge system to innovate. By restricting (through power relationships) the development of new technologies, and continuing to control labour in a manner which favours large scale 'mechanised' industries the local knowledge system has been unable to develop or rediscover the knowledge needed to process wool. Rather a set of economic barriers, discussed later, combine with a simple lack of alternative sources for knowledge. The state retains a monopoly on agricultural knowledge, controlling through direct and indirect means what knowledge can be developed. In the case of wool processing, it is not a state priority and thus the local system remains in ignorance of how to process this potentially valuable product.

3. Post-Soviet Knowledge Loss

Knowledge loss in Khorezm was not restricted to the Soviet period. In the years since 1991, when the Soviet Union collapsed, farming in Khorezm has gone through significant reorganisation, which has at times led to even more knowledge loss. Whilst the Soviet era system of knowledge governance was imperfect, it did provide a well resourced agricultural research infrastructure (Morgunov & Zuidema, 2001). The examples of knowledge loss discussed above refer to processes which were either related to Soviet-era agricultural organisation or which were on-going at the time of independence. We discuss here two instances of where the demise of the USSR led directly to knowledge loss in Khorezm.

Case Study: Kolkhoz Communism Cattle Farm

An eloquent example of knowledge loss is that of a large private cattle farm just outside of *kolkhoz Communism*[9] in Gurlan. It consists of 200 cows, 12 pigs, 70 hectares of cropped land and 15 employees. Privatised from the collective in 2001, it was sold to the local animal expert who had worked at it previously and who held high esteem within the village. He had studied animal sciences in a Moscow Institute and was a 'master' in animal health and milk processing. It seems that the specialised knowledge of this 'master' was a key rationale for why it was privatised to him and not to another individual, the purchasing process remained opaque. This was described by the current farm manager in that the 'master' had understood how to make

[9] Now officially going by another name, but locally referred in the old manner

excellent cheese, how to care for the animals when they were sick and was an 'expert' on all issues of farm and livestock management (Interview, 19 May, 2005). When we were shown around the farm, the current manager spoke of all the challenges that they now face as a business because the 'master' died the previous year at the age of 43 - leaving only young sons (the oldest being in the 8th grade, circa 15 years old) and married daughters. Thus it was left to his wife to continue as manager – even though she had some training whilst living in Moscow, she was not a 'master[10]'. Thus all the accumulated knowledge of the 'master' was lost, with very little evidence that those left behind were able to continue. "We carry on doing our own jobs as before, but do not know how to do many things that the master knew" (Interview, 19 May, 2005). The decline in the farm was palpable. Only 14 of the 200 cows gave milk anymore, there was a lack of knowledge about breeding and encouraging milk production. Likewise, the business no longer produced cheese of any sort, instead selling (less profitable and less transportable) cream on the local market. The most post-harvest processing that occurred on site was the boiling of cream to make baby food, utilising only a Chinese separator (to separate the cream) and a wood fired *kazan* (large pot) to boil the cream in. In 2005 the business was, for the first time, growing cotton - largely because they have been unable to continue making money from the cows.

Other efforts at diversification, which had been started by the 'master', were flagging for instance pig production. It was initially the idea of the master, but after he died the herd is being slowly culled. One example of knowledge loss within the farm became evident at an occasion when a first time mother pig crushed all but one of her piglets. The manager did not know if this was normal or what to do about it. They had only two sources for knowledge to replace that which was lost. Either from the Farmers Union in Gurlan which provided booklets, or from the wife of the deceased master, with few other options apparently open to them. In either instance this external knowledge could not replace the knowledge that was suddenly lost with the early death of the 'master', and with only young sons and no other knowledge reproduction strategy, this knowledge was lost to the cattle farm. This incidence clearly shows the importance of a succession of generations for knowledge loss in case there are no institutionalised avenues to pass on local knowledge.

What this illustrates in the case of post-Soviet Uzbekistan is that the agricultural knowledge system has been unable to adapt to the economic and social disruptions of post-1991 independence. There are insufficient levels of knowledge within the local system and, constrained by the state, it is not possible for the local system to innovate and create new knowledge internally, or to access external knowledge sources outside of the state system. As a corollary of this, we see how state control and interests are actually enhanced by the situation, with the farm turning (voluntarily, if for want of other choices) towards cotton production which is a central state interest. Thus the states monopoly on agricultural knowledge is reinforced, with this 'privatised' farm reverting to the centralised knowledge of the state for cotton, precisely because of knowledge loss from the local knowledge system.

Case Study: Seed Selection

Seed selection has, for some species, deteriorated rapidly in the post-Socialist period. The loss of improved varieties, especially for maize, has been caused by a break down in the collective systems of seed breeding, selection and distribution. Whilst the GoU has been largely effective in ensuring the supply of improved varieties of cotton and wheat (the strategic crops)

[10] How much of this was because of her gender and how much was because of a lack of knowledge we are unsure of.

there has been a decline in the availability and quality of improved seeds for maize and some other cultures, including potatoes (Nasriddin, Interview, 26 April, 2005). So whilst state attention is focused on the two strategic crops, which command their own breeding centres, other crops lack centralised seed selection centres. In many ways seeds are a physical expression, an artefact, of knowledge. The ability to select and reproduce improved varieties involves a complex set of knowledge, for example procedural knowledge in how to select seeds and dynamic knowledge in constantly improving strains, and the end result of improved seeds are an expression of this knowledge chain.

Seeds are symbols, invested with knowledge, which illustrate how indigenous knowledge is created, shared and used. Yet what we observed in Khorezm was that this knowledge chain had been broken. Seed improvement techniques that we know existed during the Soviet period (various archival sources; Nasriddin, Interview, 26 April, 2005) have subsequently broken down. For example the *sovkhozes* and *kolkhozes* previously conducted a lot of their own seed selection and storage for non-strategic crops whereas cotton and wheat were generally the concern of higher institutes or specialised academies (Truth in Khorezm, 22 August, 1959). This was conducted by trained specialists, within the ambit of their work at the collective farm, and these seeds were then also passed horizontally and vertically upwards through the network of collective farms (Unknown, 1988: 308-310). What improved seed did exist for varieties such as Maize in the form of imported hybrids, often labelled locally as '*Ulughbek'*, was distributed through the *kolkhoz* farm system. In post-Socialist Khorezm non-strategic crops are increasingly grown from heritage seeds that the farmers collect themselves. This reversion to heritage seeds has been significant, necessitated by the break down in the former *kolkhoz* farms and systems of seed selection and improvement (Van Dusen, 2006). If we accept that seeds are the physical manifestation of a knowledge chain, then it is fair to discuss the quality of these seeds (in terms of harvest quality and yield) as an expression of the knowledge inherent in these seeds. This is where knowledge has been lost in post-Soviet Uzbekistan.

The varieties of seeds available for crucial fodder crops such as maize and sorghum are inferior to those previously available in collective farms (Nasriddin, Interview, 13 April, 2005). The same is even true, to a lesser extent, with wheat. Whilst specialised breeding centres do exist within Uzbekistan, it would appear that high quality wheat seeds are not distributed through the former *kolkhoz* system. Whether for lack of infrastructure, finance or political will, state plan farmers do not always receive improved wheat seeds (ibid.). Indeed, our interviews identified that it was necessary for a farmer to travel to the Jizzax or Samarkand rayons in order to buy improved wheat seeds. The same is not true for all crops. Indeed imported European seeds for various kitchen vegetables and cash crops such as watermelon; cucumber and tomatoes are available in the bazaars of Khorezm[11]. Yet this importation is exactly the point, there has been a loss of knowledge of improved seed varieties and how to develop these within Uzbekistan. The increased reliance on seed sources from outside of Uzbekistan is emblematic of the knowledge lost in the post-Soviet period. Although it should be noted that this situation is complex, as vegetable production has recovered to almost pre-1991 levels (Ali et al., 2003: 21). Yet this has been because of indigenous knowledge creation and local knowledge sharing, rather than because of any explicit state assistance (see next case study, also Van Dusen, 2006). So whilst the state has continued to invest in cotton and wheat production, this somewhat myopic policy has lead to a marked reduction in the quality of genetic material for other crops, especially those which provide nutritive fodder for livestock. This is because the state does not profit from areas of agriculture outside of cotton and wheat, yet exercises control over the

[11] Vegetable seed distribution is discussed in more depth in a case study in the next section.

entire agricultural production process. This restricts the development of local knowledge because innovation is not encouraged or even really allowed.

With the break down of Soviet era capacity in seed selection, there has not been investment from the state in non-strategic crops. In some cases the knowledge to do so has 'leaked' back to Russia, in other cases the knowledge potentially exists to select better seeds but the physical infrastructure to allow this knowledge to be used, is not present. Because seeds are a carrier of knowledge, the knowledge on seed selection needs to be used to be effective, in the absence of use this knowledge is being lost, and it is only being recovered because of the growth of indigenous knowledge in Khorezm (see next section) rather than because of any state assistance. This demonstrates how knowledge loss is more fluent than might otherwise be assumed, as we see clear evidence in the case study on seed selection, of how local people (especially women) are actively creating and sharing knowledge through their selective breeding (and sharing) of vegetable seeds, using both indigenous and introduced varieties to deliver improved nutritional and economic outcomes.

4. Limits on Knowledge

"If I get more I will have to give all to the kolkhoz, there are a lot of taxes … everyone wants a tax. The environmental protection department, the customs, everyone… so it is not worth having more sheep" (Polvon, Interview, 13 May, 2005).

There are also limits on individual farmers and on agriculture in general that contribute to this phenomenon of post-Soviet Knowledge loss. It has been said that "there are no medium sized businesses in Uzbekistan, only large and small ones" (Rasanayagam, 2002: 55). This reflects the dominance of state sponsored companies in all spheres of the economy. Whether these are official monopolies such as the cotton sector, or businesses which are officially private yet are controlled by the same political class that controls the rest of society and the economy, so called 'minister millionaires'. At the farm level these restrictions are played out in a 'ceiling' that is placed upon individual ambitions and entrepreneurialism. Wealth building and value adding to commodities is possible only to the extent that ones' political capital allows, which in the case of most '*kolkhozniks'* (rural farmers) is very low. Without going into the details of the economic system, the effect that this has on knowledge creation is stifling. Farmers remain unwilling to expand their production (see above quote) because of a real concern that they will end up worse off. Processors of raw products express a similar concern (Interview, 11 May, 2005). Likewise, because the labour process remains state rather than enterprise controlled, insufficient surpluses are being generated to allow experimentation and greater knowledge flows. There is also a more direct restriction on innovation, with state norms and mandated methods preventing the development of local knowledge. Thus the preconditions for knowledge creation, to replace knowledge that has been displaced with the fall of Communism, do not exist in Khorezm, nor is the current government allowing such a condition to develop because of the link between power and knowledge, which is central to state control over agriculture. These limitations and restrictions on economic life, which have direct consequences for knowledge creation and loss, should be considered as part of the system of knowledge within Khorezm, as a key constraint to indigenous development. This is because knowledge would be able to develop indigenously were it possible for producers to profit from further developing their production and labour processes. Yet this is not possible under the current system of state economic and knowledge control.

3. Theoretical Implications

What is clear from the examples in rural Khorezm is that there is a phenomenon of 'Knowledge Loss'. This is when knowledge within the local knowledge system disappears or ceases to be available. The displacement of old knowledge with new knowledge is a natural, indeed essential, aspect of a dynamic knowledge system (cf. 'normal science', Kuhn, 1972). This is not the type of loss we wish to discuss here; indeed we distinguish between this process of 'normal science' where new knowledge displaces the old, and genuine knowledge loss. Rather when we conceptualise knowledge loss, it is it the destruction or leakage of knowledge from a discrete knowledge system. This form of knowledge loss is not replaced and thus is distinguished from displaced knowledge. So when old knowledge is improved upon and new lessons learnt this form of loss is not of concern, it is only when knowledge is lost and not replaced, that we consider this the concern of knowledge management. We theorise here that knowledge loss is an area of crucial interest for knowledge management and knowledge governance literature, because it demonstrates a failure in a knowledge management (or governance) system. Parallel to 'market failure' we can therefore speak of 'knowledge system failure' or in short 'knowledge failure'. Whilst some level of knowledge loss is probably unavoidable (through leakage into other systems) it demonstrates a failure to adequately manage and utilise the knowledge of a community, organisation or nation state. Thus it merits greater attention in the literature. Moreover, the phenomenon of knowledge loss would not appear to be restricted to any one system of knowledge, examples abound in universities, companies and indeed nation states[12]. The local knowledge systems studied in this paper certainly suffered some extreme instances of systematic knowledge loss, related to the downfall of the Soviet Union and the impediments to innovation that the governance structure enforces.

We theorise that there are various causes for the loss of this knowledge, ranging from the death of a knowledge broker, through to an attrition of knowledge due to misuse. These drivers of the knowledge loss phenomenon are explored in greater depth in the subsection below. However we would caution that the term 'knowledge loss' does not necessarily mean that the knowledge is destroyed or is irretrievable, as there are cases in which knowledge is not so much lost as 'leaked' to another knowledge system. Thus the knowledge still exists, just not in the same knowledge system. This 'leakage' is discussed as one of the drivers of knowledge loss, along with the other drivers of displacement and misuse. Finally, we discuss the theoretical aspects of knowledge loss, attempting to establish some criteria for how to classify knowledge loss as a phenomenon worthy of study in knowledge management (KM) and knowledge governance. Knowledge loss is certainly an important area of study for KM theorists, as we attempt to better manage existing knowledge resources.

1. Drivers of Knowledge Loss

Knowledge is lost from a community in a number of different ways. Detailed here are the most common forms of knowledge loss as experienced in the field research presented above. Whilst some of these modes or drivers of knowledge loss may be unique to the field setting of rural Uzbekistan, many are not. Likewise, different communities of knowledge (e.g. the corporate world) may experience different manifestations of knowledge loss, although we suggest that the drivers may be similar, even if the form they take is different.

[12] For reference to the dominant definitions of Knowledge in Singapore and Germany see Hornidge, 2006.

i. Death or Displacement

Because knowledge is communicated between and carried by humans, when an individual dies or leaves a group, the knowledge they once held can be lost to the group or community. We saw in the case of the kolkhoz communism cattle farm, how the death of one key individual, especially a 'master' who held unique knowledge, had a deleterious impact on knowledge in the community. Certainly in local knowledge systems, where most knowledge is held personally and in an unwritten form, the risk of a 'master' dying has implications on the knowledge of the community. Yet it is not only death that can cause knowledge loss, but also simply an individual leaving the group, say, to take up alternative employment. It is thus predictable that knowledge is 'lost' to a system of knowledge because most knowledge is held by individuals, not collectively. Yet we find it surprising that the issue of key staff moving (or dying, somewhat more dramatic) is considered more of a human resource management than a knowledge management issue. Thus we would argue for a greater recognition in the literature of the risks of death and displacement for knowledge loss.

ii. Misuse and Misplacement

Knowledge can also be lost if it is misused or misplaced. That is, if knowledge is not applied and utilised, then it can be lost altogether. Certainly practical know-how, *aptitude*, is lost if it is not used and transmitted (shared) in its use. We see in the local knowledge system how collectivisation and the centralisation of post-harvest processing meant that local knowledge was lost precisely because it was not able to be utilised. This was not necessarily through any attempts at indoctrination or through wilful misplacing of the knowledge. Rather the indigenous knowledge on these topics was not used, thus it was not passed on from generation to generation, and it has been 'lost' to the knowledge community. The issue of unique indigenous knowledge being 'destroyed' is discussed in the literature, especially in cases of the medicinal uses of plants and of indigenous methods of conservation (cf. Stevens, 1997; Benz et al., 2000). However, in the case of Khorezm this indigenous knowledge has been lost or destroyed for some time and it is only now (with the paucity of knowledge in the post-Soviet agricultural system) that this loss is acutely felt. As lamentable as the loss of indigenous knowledge is, the more important issue now is preventing the continued knowledge loss which is not being matched by developments in the rural economy or local knowledge system. The converse aspect of this is how indigenous innovation can be used to recreate knowledge which has been misused and misplaced, whilst preventing further knowledge loss.

iii. Leakage

Knowledge loss does not always mean that the knowledge has been destroyed or lost entirely from the universe of knowledge. Rather from a systems perspective, all it denotes is that knowledge has been lost from the community or knowledge system. Thus a farmer moving from Khorezm and migrating to Russia (a common occurrence) carries with them a great deal of knowledge which is 'lost' to the community in Khorezm, yet which contributes to agricultural knowledge in the recipient locality (thus it is displaced). We label here this as 'leakage', a form of knowledge loss which is perhaps less dramatic than knowledge 'destruction'. The impact on the community (or potentially corporation) is perhaps similar in that their access to the knowledge is lost. Yet leaked knowledge is potentially retrievable (though it may not be) and does continue to exist in another knowledge system, with which knowledge sharing should still be possible. Thus leakage is the least dramatic form of knowledge loss, yet it is still an important driver.

Another form of knowledge leaking refers to the change of knowledge from one domain into another. Medical knowledge in cattle farming may no longer be used in that particular domain but may find acceptance in small animal farming.

4. Conclusion: Towards a Theory of Knowledge Loss

Knowledge loss is not a remote phenomenon, unique to one knowledge system. Rather we argue that the loss of knowledge is an issue for other knowledge systems as well. Knowledge loss is certainly a concern for anthropologists working on indigenous knowledge, fearful of 'losing' indigenous knowledge entirely as a result of modernisation (cf. Cox, 2000). Equally, staff movements within the corporate world probably lead to a large amount of knowledge displacement, yet staff (and thus knowledge) retention is more often seen as a human resource than a knowledge management issue. Similarly in academia, which thrives on the wide interchange of knowledge and ideas and openly promotes the exchange of knowledge, much of this knowledge can be 'leaked' (i.e. it leaves academia for another knowledge community, say, a corporation) or it can be 'lost' altogether. Thus we attempt here to explain in theoretical terms how knowledge loss operates, what are the drivers of knowledge loss and how these can be ameliorated. We suggest that knowledge loss is a failure of knowledge management insofar as it demonstrates a lack of knowledge sharing, dissemination and use. The central argument being that knowledge must be reproduced (or stored in a repository) for it to be used and to continue to exist. Because local knowledge resides in individuals, who are apt to move to different knowledge systems (leakage) their doing so carries with them a considerable amount of knowledge. Key to reducing this is effective knowledge sharing during the time they are within the community or organisation. This provides the inherent benefit of greater knowledge utilisation through greater knowledge sharing, as well as reducing the risks of knowledge loss. Yet, individuals do not always share knowledge, when they do this sharing can be partial. In many cases this is because of the high transaction cost (and risk) associated with sharing their knowledge. We argue that knowledge management and knowledge governance theory needs to inform institutions (informal and formal policies) which can introduce better protections for individuals to share knowledge, in order to reduce the transaction costs of knowledge sharing. These transaction costs can be lowered by guaranteeing continued ownership of intellectual property, by establishing a proper policy framework for academic honesty and by enforcing these rules in a transparent manner. In the case of local knowledge the transaction costs are somewhat reduced by knowledge sharing within the family, shown in generational transfer of mastership. In the same way should projects, corporations and ultimately nation states develop structures which allow for enhanced knowledge sharing, by reducing the transaction cost of sharing this knowledge. Part of these systems must allow for knowledge which is no longer relevant, which is not useful or which is simply wrong, to be replaced by more appropriate knowledge. In this regard simple databases are somewhat counterproductive as they do not encourage the dynamic displacement and replacement of knowledge, which whilst it involves some knowledge 'loss' is actually a knowledge creation and sharing process. Thus we theorise knowledge loss as a phenomenon to be evidence of poor knowledge management. In its own right it is a failure of management and governance to allow knowledge resources, expensively produced within the community, to be lost. On a wider level it evidences a lack of knowledge reproduction and retention, which can be seen as a result of excessive transaction costs and risks to knowledge sharing.

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