

## [INTRODUCTION TO PROJECT BACKGROUND]

L: This business is probably slightly unusual in that we are not effectively growing any vegetables or potatoes, or crops to our own account. But what we do is we contractually, or we contract to supply water to people who grow those crops on our land. So we have a contractual obligation to all of those people to supply them with water.

Int: Yes, it's a very interesting case because there are lots of different arrangements around water but I haven't encountered quite this set up before.

L: And having read and I know it's a very very short synopsis of what I'm sure is a massive piece of work, but there was a few things there that actually would have made me think about the way it affects our business and even some of the ways that you are reporting it. I mean, I question why you would report things related to population, so when you say something per capita, so in overall when you are talking about potatoes the consumption per head of the population has fallen, but the tonnes of potatoes that are consumed and produced in the UK is relatively static because the population is increasing and therefore perhaps reporting it as per capita actually distorts the figures slightly, it just means that there are less people eating potatoes, it doesn't mean that there are less potatoes being eaten.

Int: Well, I guess it depends on which perspective you look at it from, because we were trying to understand how the water use implications are changing over time and we couldn't compare how much veg the UK supplied itself with in 1998 with 2015 without dividing that by the population.

L: So I certainly understand where you are coming from with that, but if I was working for the EA I would be excused for thinking that because people are eating less potatoes, there are less potatoes grown, and therefore the potato industry needs less water.

Int: No that's not what we would be trying to communicate. I guess the same amount of potatoes might be being grown, but the market share in terms of competing other food stuffs, has gone down.

L: Compared with rice and pasta effectively and that is, we probably have a slightly more ethnically diverse community which therefore means that diets change and we are more adventurous in what we eat so diets change, and probably more importantly there's lots of busy people out there who think that boiling a potato just takes too long.

Int: I think that's it. People prefer to have food in the cupboard that they know is not going to go off at any point and although potatoes are storage vegetables they still don't last for two months, and

people are less certain about how much time they have available to prepare things, and they don't want to plan ahead.

L: So there is all of that, and peeling potatoes is...

Int: But I've been trying to eat a lot more potatoes since I started working on this project!

L: To be honest with you I don't eat that many myself. But that was just an observation, and just trying to understand the thought process behind that, because the population goes up and consumption comes down per head of capita, but if the market is static that's what you would expect to see, so that's not actually telling us anything very different from what we really would expect to see because if the consumption's the same and the population goes up, everybody has to eat less, because effectively there is less to eat.

Int: We don't know specifically about the consumption because there's a lot of waste. So the figures that we have are what the UK supplied itself with, and we need to know whether the way we source and the composition of our fruit and vegetable supply is resilient to water stress. That's the aim of the project. So the first work package that was looking at these overall national figures, that was trying to see how the water scarcity footprint was changing... it wasn't calculated per capita, it was only presented as per capita at one point, it was calculated for the whole thing. So we have a lower WSF for potatoes today than in the past because we used to buy more potatoes from Egypt, but we source a lot more of our other veg from Spain and other places.

L: Yes, because we eat more veg out of season, so invariably because we eat it out of season that must compound the water scarcity...?

Int: Well, yes, because we are getting the veg from places that are very water scarce.

L: Because they have the climate to be able to grow at that time of the year, but in order to be able to grow at that time of the year they have got to use irrigation water as opposed to rainwater.

Int: And it's not purely just about the fact that they are growing it at a different time of year, it's also that in some ways, I'm guessing, it's actually easier to grow on a very big scale in a place where the environmental conditions are more constant, so if you have less rainfall it's less costly to deal with, it's easier to grow things on a bigger scale.

L: And certainly with veg production, if you, the way in which you treat the soil in introducing vegetables, you are very very hard on soil, so therefore, soil, if you had fairly inert soil that was

treated as a growing medium rather than a living breathing thing you probably can produce veg very cheaply. And you know if you're in America in the heartlands of America where you've got thousands of miles in each direction before you hit the sea, the climate is very stable. Unlike here where, you know, last night, I have a guy that lives 2 miles that way, he had 6mm of rain. We had 8mm of rain and I've got another farmer about four miles that way and they had 12 mm of rain, so over about 6 miles that's 6 road miles, we've got double the rainfall, nearer the sea, to what we had inland. And that could be flipped on its head tomorrow night, you know, but it does show that even in a country of this size, the climatic variability is huge. And he's in a valley going that way, and [REDACTED] ridge runs along here, which would be the highest part of [REDACTED], where the higher rainfalls are right on the top of the ridge, and it's only 50 metres difference, but it's just enough to influence how the rain falls. But I digress. So just going back to where we started, perhaps just to understand what you need from me a bit better before we start?

Int: [Introduction] Firstly, how many years has this farm been here for and how many years have you been involved?

L: So this estate is family owned and the family have owned it since 1937/38. We are now into what is the third generation of a family member running the estate. It is a lightland farm that historically grew every crop that you can imagine, historically you could live off the estate - whatever you wanted, fruit and vegetables, meat, bread, beer. You could have done the whole lot if you'd wanted to historically. There's a lot of property so a lot of people lived here, they had their own maintenance, had their own forestry, you know all of that. But that had all become quite unsustainable. So over the year's it has gradually been dismantled in a way and it's a much more traditional estate. So we grow what we would classify as combinable crops for ourselves, so that's anything that'll go through a combine and erm some vegetables which can be harvested, like vining peas or dwarf beans, we still grow ourselves, and we also grow a lot of sugar beet, sugar beet is a major major crop. Then all the sort of, the veg, and by all the veg I would be talking about potatoes, onions, carrots, parsnips, are all on... We let the land to a professional grower and we provide him with services as irrigation, so, and we do other things as well, but we supply irrigation water to those, um.

Int: And can I ask how local... is this another local farmer?

L: They are not that local, some of them. So our main potato guy is the most local. He is about 10 or 12 miles away from where his base is, but he grows about 400 Ha of potatoes and that would be over quite a large area, of which there are 70 Ha of that here, and there's some on his own farm, and he rents ground off a lot. So this rental model is quite normal in this part of [REDACTED] (you've got to be very careful with the term... it's normal for [REDACTED]!). We then have another potato grower that we do a little bit with, about another 40 Ha with, who grows for a specific market, so they are salad potatoes, so they are grown as salad potatoes, and he's part of a wider organisation called [REDACTED]. So that's the potatoes, and again he's not that far away, he would perhaps be 20 miles away. And then the carrots and the parsnips are both grown for the same company and that's a company called [REDACTED] growers who are based in [REDACTED], so that's about 40 or 50 miles away,

but again basically they have messed all the ground up around their factory by growing too many carrots and parsnips, so gradually they are growing further and further afield, so they've been pushed up here. So they grow a lot of carrots and parsnips in this area.

Int: And do they bring their own labourers, do they bring their own machinery?

L: For cultivation, planting, harvesting, they do all of that. They actually do spraying as well, but we do all the irrigation work for them. But for the potatoes, they do planting and harvesting, but we do everything else. And then the final crop, which is the ones that are furthest away, is a crop of onions and they were actually loading some onions into a lorry as you came in, and they are going to a grower in [REDACTED]. And his company, which is called [REDACTED], or some of their produce goes as [REDACTED], and these are very specialist, they are [REDACTED] these are, so if you go into the supermarket they will be marked as [REDACTED], and they are in Tesco's finest, Waitrose, M&S. They are at the top end... they are quite expensive, they are a very very high value crop and the only reason they are here really is a) that he's a friend of one of my colleagues, so that was an introduction, and secondly we have the ability to be able to store them here to the right standard. So we can offer more than just land, so that's why he's ended up here. Historically we grew daffodils as a crop, so, and daffodils are bulbs just as onions are bulbs, so the mechanisms for storing it are very similar, so that gives us an opening.

Int: So at what point did you move more into contracting out field veg?

L: So basically, carrots. I've been here for fourteen years and carrots have always been... basically carrots and parsnips are a very specialist job and therefore I don't think erm, we'd have to go back a long way in history to find that an estate like this grew carrots. Carrots are very... I think there are probably only 6 carrot growers in the whole of the UK. Or 6 growers control 95% of the carrots. So that's, carrots have always been in that arrangement. Potatoes, we grew our own potatoes until 2008 and we were struggling a little bit to make that financially stack up because the whole of the industry was a little bit in recession, the return for potatoes was poor, we had quite a lot of old equipment. The labour we had that was expert in that field were all approaching retirement age, so it was probably a time to change. So what we have done is we've changed a business which was based on 100% risk strategy, to a business which has very little risk at all.

Int: So at the time that potatoes were being produced were they produced not under contract?

L: No, they would have been contracted to a merchant. The soil type here isn't very good for growing high end quality packing potatoes, so most of the potatoes grown around here end up in processing, so for crisps... so we'd have done quite a bit for Walker's crisps, currently there's a lot grown here for Kettle's crisps, and all potatoes stored on this site at the moment go to a company called [REDACTED], and they supply into McDonalds and McCains and well, so it's more of a processing... so it's the fast food, unhealthy end of the market is probably what we are supplying

into, but that's just because our soil type is very sandy and you can't get a nice bright... so when you go to the supermarket and you want to buy a baking potato it would need to jump off the shelf and say "eat me!". Whereas something that's dull and has been scuffed by a load of sand never quite meets that... So the market's developing in different ways. But when we grew ourselves it would all have been contract, but the contract prices were... we were having inflation pressures from fertilizer, labour, machinery all those sorts of things, but the contract prices weren't moving in line with that, so the decision was made, way above my pay grade, that that was the end of it, so that's the way it was. But the irrigation systems would have been put in with potato production predominantly in mind. So probably the first irrigation went in probably in the mid seventies, as a result, I would imagine, of '76. I think that focussed everybody's mind that that was a major impact and a major effect on a lot of businesses. There were lots of government grants and lots of things, so that was.... But in 2011 we had a major upgrade of our system, and we are currently digging gravel here purely with the idea of creating winter storage, so we will have a lot of water available to us. I mean we have the water available to us now, but we need to find ways of storing it, so that nobody can come along and say, "it's a dry year, you can't have it".

Int: So has the decision to put in those reservoirs been implemented because the EA is putting more pressure on?

L: Well, I think that it's fair to say that the EA are very active in trying to make a limited resource go further, and again with the growing population that is creating huge amount of pressure on the system. Agriculture has a real problem in that there are an awful lot of people who hold irrigation licenses who don't irrigate, so the environment agency has to look at the risk profile that that presents, so therefore, the EA see that the farming industry could extract this much water, therefore they put restrictions on it. And we have had one, I think it was 2010. I'm not 100% sure it was that year, but it was a very dry winter and we didn't see much opportunity to fill our reservoirs even. So when you get that sort of thing we actually had people who reduced their potato area and their parsnip area because the EA were talking about a 25% reduction in everybody's licences, just a carte blanche regulation that they were doing to try and protect the underground aquifer. And that frightened us. It frightened everybody, because obviously if you spend a lot of money on growing a potato crop, if it dies because you can't water it, all that money is lost, so therefore the irrigation is in a sense, an insurance policy. So we as a business have always had interest in irrigation, but we upgraded the system because the strategy of this business, (and this project has now been running for nearly 20 years because it's had all sorts of planning problems that has made it a nightmare), and we tried to get a grant to do it for some reason or other when I was just joining the company, i'm not exactly sure of the detail, but basically the grant application was unsuccessful, so we then went for gravel extraction, so, and we knew we've got gravel under here so we've done all that, but as soon as you start talking about digging holes in the ground the population don't say, "that's a good idea! Get on with it!". They tend to find all the reasons you can't do it. So I think it was four years in the planning process, got kicked out twice, basically on vehicle movements, on traffic. Traffic is the big problem because basically if you want to move a million tonnes of gravel that's a lot of lorry loads, and every lorry has two vehicle movements because they have to come in empty and go out full, and local gets very concerned about this amount of lorry traffic, and there's a primary school in the village, and all of the things... And we weren't unsympathetic to all of that, but the reality is that there's fourteen lorry movements a day, and if I'm loading sugar beet out I have sixty lorry loads a day, and nobody ever questions that because it's just the norm. So it's about being informed. So

we've done that, because winter storage is a way of protecting the long term asset, and there were grants available, and we've put the infrastructure in. So we have fantastic infrastructure for pumping water, you know, state of the art, absolutely fantastic. We just, the water at this moment in time is not exactly where we want it to be.

Int: But it's going ahead?

L: Yeah, well, we should be pumping water.... we've got two reservoirs. We've got one reservoir here which we've been using since 1998 I think and we continue to use that one. That one holds 10 million gallons of water. And this project will provide us with two more reservoirs. One of 45 million gallons and another one of another 25 million gallons, so we'll end up with 75 million gallons of water storage which is a lot of water. For an agricultural business that is a lot of water. We should be starting to fill the 45 million one in September '19. So there's a big hole there. If you've got 5 minutes at the end of this I'll take you there and show you it, because that will just join a few of the dots up. So that project is going on and it's all about protecting the water that we've got, so that when we offer it to our customers, we know it's there.

Int: Just a question about that. So you are charging them a monetary rent, you are not taking a proportion of their sales?

L: No.

Int: And if the water supply was limited to the customers is there something in the contract that you would then have to return some of the rent or anything like that?

L: No. So, historically when we started doing this, and it would have been a colleague of mine who would have started this going, we put into their contracts that they could have 6 acre inches of water in any one growing season, unless the EA cut our licenses for reasons of dry weather or whatever, in which case that 6 would be reduced pro rata with the reduction that the agency enforced on us. So that would be loosely how it worked. And if I contract to supply you with 6 inches of water, I effectively have to take that 6 inches of water and put it over there and say that's yours, and that's where it stays. And in a way what that was doing was... and a lot of these people were only using 3 inches of that 6, so that was limiting the area that we could use water on, because not only that, but in terms of license protection, if we are not using enough, they want to take it away, so that wasn't working particularly well. So I've reviewed it, so now what we do is, in their contracts, all their contracts are much more bespoke. So now if you only want 3 inches of water, you only contract to have three inches of water, and I only put 3 inches of water aside to you. If we have a really really dry time and you need 4, you've got to come and talk to me and negotiate that. I'm not going to fall out with you over it, but I have to then balance my own needs against whether I can afford to let you have some more, and if I am going to let you have some more, whether I'm going to let you have it at the same price or whether I'm going to capitalise on that. So now we have

people much more honed down to what they want to use, and going forwards we have records of what they all use so we can pretty well project what their largest (and they are not interested in their average they are interested in how much is the most they've ever taken because that's the bit that could reoccur), so that has freed up quite a lot of water to allow us to look at irrigating more of our own crops, so sugar beet is one that we'd look at. So it's created some opportunities. So you talk about efficiency, so that would be in a sense, it's not an efficiency as such, but it is a more efficient use of our license. So, the change was only fully implemented last year, but we have actually sold twice as much water this year as we did last year, now 50% of that could well be down to climatic conditions, but certainly 50% is due to the fact that we have been able to be less cautious about the area of land that we plant that we know we can actually irrigate, so that has been a help to us.

Int: And, so there's quite a few questions that I need to get through, that I don't want to forget to ask. So what is the total size of the farmed area of the estate?

L: So the estate, or the land that we farm is 2400 Ha of which 1650 Ha is owned and the rest are farmers that we farm for. But we take on responsibility for, it is incorporated, it is all farmed in the same way and there is irrigation on there and we do, some of the vegetable crops are grown on those.

Int: So do you grow sugar beet for other farmers?

L: Yes, well we grow, it's what they would call a contract farming arrangement, so basically we are contractors for the land owner but we grow all the same crops as we do here, depending on land suitability, but to all intents and purposes. There are two other farmers and you wouldn't know that it wasn't ours, all the same equipment, all the same crops are all grown, it's just we don't own the land, we just take an income from it.

Int: And is all the farmed area irrigatable?

L: No. There would be... probably 500 Ha that doesn't have irrigation on it. And then that 2400 Ha does still include about another 500 Ha of woodland and pastures that again would never be irrigated. So we are probably looking at 2400 Ha of land that could and is irrigated, albeit on a rotational basis.

Int: So I'm assuming that the veg growers are coming in on a rotation with your sugarbeet and the other things that you are producing. So is there any guarantee that from one year to the next that the same farmers will come back... I mean are those relationships...

L: They are all long term...

Int: Are they contractual beyond a year?

L: No, they have an annual license, so in theory they could all walk away at the end of each year. In reality, farming's not like that. You know, so, the most recent partnership would be with the onions, that's six years old. Our main potato grower we've now been working with for 8 years. We did have one we worked with for a couple of years but that didn't work very well, so he, well we both agreed to part. The salad potato guy's probably been 7 years, and the carrot and parsnips could be 20 years. So they are all what would be classified as long term relationships. And sort of sat here today I can't see any reason why any of them would end outside of a bereavement that causes the business to... Or I can't, or a financial problem, I cannot see.

Int: So they are very well-established, trusting relationships?

L: Yes, so we work with them. You know, and we want to offer a good service. So if someone says to me, "I want that field irrigated", it gets irrigated. We pride ourselves on offering A class service, and that's what we are contracted to do.

Int: So they make decisions about scheduling?

L: Yes, so they schedule it all in. I don't make any decisions on scheduling, but I do manage, obviously if I've got four different people all asking for water on the same day, somebody has to be referee and that's me, so I decide where we go and who's needs are the greatest. I don't like playing god. So what I am is actually a bit of a bully about how this works, because I take an interest in where the scheduling is at, and have access to the scheduling so I can plan the work. So if I see huge peaks in demand coming up, I will encourage some of them to start earlier, and I'm always doing that. Nobody ever goes short, but sometimes they start earlier than they would like to, and then it rains and they'll say, "oh, we didn't need to do that". But it works, and so therefore nobody's ever upset about it.

Int: And the water sources that you use on the farm, is it all surface water?

L: No. So we have erm, 1,2,3,4 boreholes, so they are all licensed boreholes for extraction from the first of April until the end of October. So they're, some of them will directly feed onto a hose reel and will do the whole task. The ones actually that are within our new system in our ring tend to feed back into the reservoir, and then we pump it out of the reservoir again into the system, so there's two that are set up to do that, but if the reservoir breaks down they can revert to doing it the other way if necessary. And then we have, our biggest license by far, comes out of a river, and that river,



the license on that, and that is a big license, it's a river called the river [REDACTED]. It runs all the way through the estate, it's about the same width as this table, so it is a tiny little river. It gets a bit bigger as it gets nearer to the sea, but it isn't a very big river. And the license that we have is a hands off flow license, so we have to ring the Environment Agency every day and ask for permission to pump water, and if there's the...

Int: So it's not just the case that they'll tell you to stop?

L: No, the onus is upon us to ring them every day, so we ring them and we say can we pump today and they'll look at the hydrology reports and say, "No, there's not enough water going down the river today, you can't pump", or they might say, "you can pump at half rate". Because there are two numbers set and one allows us to pump at half rate and one allows us to pump at full rate, so we've set our pumps up to be able to, there are two pumps so we switch one on or we switch both on.

Int: And that's for winter pumping?

L: No, that license is now that you can pump any day of the year providing there is enough flow in the river, so that's quite...

Int: And does it change, the amount of flow that's required to be in the river change, or...

L: No, it's the same throughout the year. What does change slightly is that if we have a lot of winter rainfall, if I phone them today and we've had a lot of rain they might say to me, you can pump until the first of March, and then give us a ring and we'll see where we are at, so sometimes they'll give us a longer period that we can pump over. And, if you ring them on a Friday, because they are a government organisation, you normally have permission to pump until Monday, or no permission to pump until Monday. So if I'm desperate for the water and they say no on a Friday I know I can't do anything over the weekend, even if it rains, but if I say yes on a Friday, I know I can pump until Monday, so I guess there's an equaliser there, sometimes I win and sometimes I lose. So that's how the system works. It sounds a bit draconian, and it is a bit of a pain, but in terms of protecting the resource, we don't really have too much of a problem.

Int: And are you satisfied with where they consider the river levels need to be?

L: The monitoring? Well, they have a gauging station which tells them lots about the river. The river [REDACTED] although it's a tiny little river, it was one of the first rivers to become a catchment sensitive farming river. It is very well monitored, we have more scientists walk up and down it than I think there are fish swimming up and down it! So it is very very well monitored. So it's very difficult to complain about it really. I mean they have changed the gauging station once, which I think maybe

works slightly to our disadvantage, but only in one season have we had a problem getting enough water, which is why we changed the bore licenses to extend the period, so we can use any unused bore license to put into the reservoir if we are feeling vulnerable, so we are trying to manage it to maximise the amount of water that we can get, and that becomes a lot easier when we get more storage, because as soon as you've got more storage you've got a bigger buffer, and if you've got a bigger buffer you can deal with the variability that comes. We work with an academic who specialises in rivers and catchments and how they work and he actually changed all our original applications and told us to apply for our pumping stations somewhere else, because he walked the river and said, "if you apply there they'll have a job to refuse you because there's twice as much water there as what there is there". And I guess that's the sort of advice that you need, and we are not compromising the river. And we can take a million gallons a day out of the river, and even when you are taking a million gallons a day and, let me put it into perspective, that's 26 litres per second is a million gallons a day. So I'm a sad person that knows that! But when you turn the pumps on and you are taking that quantity of water, you cannot notice any difference. It does not affect the river at all. You cannot see that it's taking water out of the river, and it is, in a way, that's the way to capture it. So we are very focussed on trying to get to this end goal of being able to try and store a year's supply of water on peak flows out of the river that then allows us to sell that on. And going forward we will look to supply more of our neighbours, we will look to irrigate more of our in-house crops, and maybe even join up to some of our contract farms to join our main up so we can pump water from here, but we are already pumping it... we have 23 miles of underground main, so we are already pumping that far.

Int: Wow, that's far! So you don't have any licenses of right on this...

L: Yeah, we have... so there are... we have one license of right. Erm, and that's on a contract farm, and then the two licenses here that actually feed into the reservoir... No, they are time limited, I'm fairly sure they are... I think so... I think they are time limited, but they have been reasonably recently renewed, but I'm not a hundred percent on that.

Int: Would you have any idea of when they would be up for renewal?

L: I think not until about '23/'24 somewhere like that. The one that is up for renewal which is the one that we are most concerned about is actually the river one, and it was always based on the fact that we had to have the winter storage available, and it's due for renewal in 2020 and we are not going to have a lot of data about how much of the water has been taken out of the river, so in theory they could take that off of us, but in practice, um, it would be such bad publicity for everybody, and it would go against everything that everybody's trying to achieve, and we are constantly talking to them about it, so it would only be if somebody in a very high place decided that if they were going to apply the rule literally, would we have a problem. Because ultimately the way forward is for people to store water, and then use it at a later date. So to actually remove the licence that allowed somebody to do that would be counter-intuitive I would have said, wherever you sit.

Int: Although a lot of farmers that I have spoken to have said that they fill their reservoir using water abstracted in the winter, but then when it gets to the summer the environment agency wants them to use the reservoir water to irrigate, but they prefer to use their summer abstraction from the river to irrigate with because they don't want to use up what they've paid for in the reservoir, and they are keeping that as...

L: And I guess if you are on river abstraction you can understand the logic of that, because once you've got it you've got it. And if you suddenly go into a dry time and they slap a restriction on taking it out of the river and your reservoir is dry, then...

Int: Then you can't do anything

L: You can't do anything, so that's quite important. And from our own... from where we are at the moment, right, even, it takes us to fill our 10 million gallon reservoir we've got at the moment on our peak flow it takes us 10 days from empty to fill it. Right? If we are pumping out of it we can empty it in 7. So the idea that you would empty it in 7 and then hope you had the rights to refill it which would take 10 days, you'd never catch up. So we use it as a giant holding tank at the moment, which is why we feed two of the boreholes straight into it, so the minute we start pumping out of it we turn the two boreholes on to start refilling it, so it acts just as a huge, we've got this 10 million gallon buffer, which we are eating into every day. So I do get to the times where I pray for rain. And that's how we have to manage it until we get more reservoir capacity.

Int: And so you talked about having more reservoir capacity so that you have a year's supply of water. Can you imagine a situation where you had two years in a row where you couldn't refill your reservoir? Is that something...

L: Er, I think if you subscribe to climate change then there is a possibility that that would be the case. Erm, and, but I think if we got to that point we've got much bigger problems and although you can never take this as read I think if we got to a situation where we had two years back to back drought you would see government policy being implemented that allowed people to protect the food supply, because we would be, overall, starting to get into quite a difficult position with food supply. So in theory that would be a big problem. In reality I'm not sure if we would actually be allowed to get to there. Now, if it were to be a regional problem, so the only place that's got this problem is East Anglia then I would see, and that has implications, but it has implications for an awful lot of farmers and a big percentage of fresh veg grown in the UK.

Int: And hypothetically speaking, what do you think farmers could do to... do you think it would just be a case of, for the farmers that could afford to do it, putting in more reservoirs to have a longer supply that would cover them for two years?

L: The thing would be that it would be a reactive solution because you wouldn't be able to do anything in the year, because by the time you'd got planning and built it and filled it with water that's probably going to take you three years anyway, so you are reacting to try to prevent it. I think that the whole industry, because of the threats that come from the EA, even away from an extreme event, are such that licenses of right and licenses that require renewal are always under threat, to actually have more storage would be the way forward, but storage is very expensive, so I would imagine what we would see is a government reaction where storing water becomes funded in some way, whether it's through tax breaks, or grants, or whatever, so that makes better use of water resource. And, as a tax payer, you would like to think that somewhere in a time of crisis one of the things that the government could do, was claw some of that water back if it needed to, back into the public domain. That would be something that perhaps ought to be considered. Putting bigger amounts of infrastructure in. But if all the reservoirs dry up, we can start pulling on some of that resource.

Int: So it would be not the kind of problem that you would expect farmers to be having to deal with on their own? Because sometimes it seems at the moment that very much the onus is upon individual landowners to put in reservoirs, and there's not as much help, I've spoken to farmers who would prefer more assistance from government financially.

L: I think that putting a reservoir in is an expensive project. I mean this project we are doing here without the gravel would be a 2 million pound project, and although this is a big business, a 2 million pound capital project, without any help from anybody, would be... the payback time on it would be a long long while. And if you've got 2 million pounds to spend you wouldn't be spending it on an asset that you were just going to sell water to your neighbour effectively, you'd go out and buy another farm. It just wouldn't happen. So without some incentives to make it happen it just won't happen, because there isn't that much money in the... There will be people out there, some of the massive potato growers will put reservoirs in because they've got this crop that they need to protect, and they have the turnover and the profitability, so I suppose [REDACTED], and I don't know whether they are on your hitlist of places to go, but that is a massive business that has lots of water, but it is all about high value crops, you know, onions, potatoes, all sold into high end markets, and they are... and water is the only thing that makes that land farmable.

Int: So do you think that once a farm has made a very big investment in its water supply that limits the range of crops that it might be interested in producing?

L: It definitely drives behaviour. So for this business here, I won't go on too much of a tangent, but at this moment in time it is very fashionable to be improving your soil, so Michael Gove would talk about the 25 year vision where there's no-till cultivation and we're looking to make the soil more resilient, and reduce runoff and all those sorts of things. As soon as you grow a veg crop, you are doing everything wrong. So in theory you'd be better not to grow any veg here, that would meet the criteria of... so that would be one solution. But people have invested these monies and they need to get the return, so it's all driven. And the other thing is we have a rotation, and the rotation in a

sense gives us sustainability, so all of these things have their places. But in theory if you follow the ultimate government policy you would stop growing vegetables in the UK and import them all.

Int: And do you think that's what the government would prefer.

L: Well, I think that under current policy and under some of the things that the Brexiteers would have driven it would suggest that importing cheaper food from around the world would reduce the average cost of a shopping basket in the UK, but if you start looking at the global environmental impact of how those crops are produced, some of the practices that are used to produce some of that is way way below what the consumer in the UK has come to expect. So it is a little bit of you pays your money and you takes your choice, but for me, locally produced to a high environmental, ethical welfare standard is what UK agriculture is all about and that should be something that everyone should be more focussed on. And so people trying to get cheap food in easily is not necessarily delivering anything like what people think and if you talk about Spain and Spain wouldn't be one of the countries you'd be importing it from, but to produce a tonne of potatoes in Spain requires a lot more of additional water applied to what it would in the UK, and that is putting more pressure on a resource. Whereas all the water that falls on ■■■ estate ends up in the ■■■ and goes out into the North sea, so that effectively as a resource is lost, so if I can capture it, store it and use it when my crop needs it it has to be a win-win for mankind really. But that's a very idealistic overview of where it should be. But at some point somebody's got to start being a little bit more idealistic about this otherwise we'll just keep going round and round in circles and curing problems that we've created that we all knew we were creating 20 years before, and you've got to stop the cycle.

Int: And in a complicated fruit and vegetable system, who do you think is best placed to drive that change?

L: I'd love to think it was my fellow farmer, but unfortunately it will be government policy because it will be money-driven and it will all be about how it's funded and... one of my soap boxes of which I have several, is that agriculture follows legislation and until agriculture starts leading legislation, so we should shape legislation, not follow it, and until we actually start doing that we are going to continue along these cycles of complaining about this and doing that because we have to, rather than because we want to, and that's where we need to change, so we should be saying, "What will benefit UK agriculture?... More water storage". So how can we make more water storage happen? Well that needs to come from Government. But we should be making a much stronger cases for why we need that. And that's just one of many things, you know water's important, but it's only that much in something that's this big.

Int: But many of the farmers I've spoken to have emphasized that it's really the consumer who drives change and "is king".

L: At the end of the day your customer is always right, whether you are supplying him with water or whether you are supplying him with potatoes and carrots, he is always right, you know, you've got to get him to buy it. So consumer is... there's no point in me growing anything if the consumer doesn't want to buy it, so I have to produce something that the consumer wants to buy, so ultimately the consumer is king, we have to satisfy him and um, but the consumer, I believe, his views are engineered by supermarkets. So he actually buys what the supermarket has very clever indoctrinated him into (and indoctrinated is a very strong word really in that situation), but if I wash all your carrots and put them in a bag they look more attractive and you've got less work to do and I can charge you an extra 10p a bag for them and that helps my profitability and it gives you a bit more free time, a bit more quality time to spend with your son, and that's how it's marketed to you. So ultimately, the consumer looks for that nice plastic bag with these carrots in, and "plastic" is now a swear word, so you know, so we've got all of this going on. So it's driven by supermarkets, and supermarkets tell people, this is what you should buy, because this is what we stock and that's what people buy. And that's in a way why local produce and farmer's markets and things like that was set up, and it's still a very small share of the market, but when you listen to things like, and I think it was Gove that said, that he would like to follow the French model, and the French have said that within 5 years they want 50% of the food consumed in France to either be organic or local. Okay, so, I'm not sure about the organic, but the local I think is a really good model that we should all start to follow, but that does mean that you get your crinkly vegetables and your potatoes aren't washed and you get your hands dirty when you pick them up, and all the things that nobody really likes. And that would change how people perceive their food production. So it is driven by people, and it is driven by supermarkets, and supermarkets will put specifications on that they have to be this size, this length, this shape, straight, all those sorts of things, and some of that is controlled by how you grow them, you know the cultivations you do, the plant populations you get, when you apply the water, how much you apply and all of those sorts of things are all influencing that. So the supermarkets drive behaviour in that way. From where I sit I actually think it's naive to think that the consumer drives the supermarkets. I think it's far more complicated than that. I think, yes the consumer does drive the supermarkets, but the supermarkets have educated the consumers.

Int: And also consumers are very diverse they want different things, they have different priorities, whereas there's perhaps less diversity of interest represented by a relatively small number of quite large businesses that represent a bit of a bottleneck I suppose in how food gets from farm to the majority of the consumers, so perhaps the retailers have a more unified perspective that they can drive.

L: Yeah, and at the end of the day they are businesses, big businesses, and they need to make a profit, they need to cut down on waste, they need to make sure they put things on their shelves that people are going to buy. So there are lots of good reasons and the crinkly vegetables, and the misshapen vegetables thing... we can all get very passionate about that, but in reality that's a disaster for agriculture, yes it cuts down waste. But if you buy crinkly vegetables do you buy more of them?

Int: Possibly.

L: You'd probably buy the same in reality, you might say, "these are cheap this week, therefore I'll have a few more", and there's a bit more waste, and that's fair comment. But to all intents and purposes, if you have misshapen carrots, the consumption of carrots in the UK will not go up by the fact that they are misshapen, and you, because you are buying something which is mis-shapen and doesn't look quite so good, want them cheaper. Because you may have to chuck a little bit more away. So that means that yes we can, we eat more of the produce we grow, so the waste is less, so that's a plus, but you want to pay me less for it. So therefore my returns go down.

Int: And you've made a big investment in the technology that permits you to grow to the specification.

L: So the whole thing is not actually helping agriculture. If it takes land out of... if it means that the UK grows 100 Ha less carrots every year and that 100 Ha is used to grow cauliflower because there's a shortage of cauliflower, that's a win. But I don't think that that is how it works. But I would say that consumers in theory drive supermarkets, supermarkets drive their producers.... but the reality is that supermarkets drive consumers and consumers buy what's put in front of them and that drives...

Int: And the supermarkets drive the producers as well?

L: Well, they have specifications and one of the things around if you take that back to our letting of water and how we would do that... if you are contracted to supply a supermarket and you don't give them enough of the crop you are penalised for that, so the water becomes an insurance for that. So they are buying enough water to make sure that if they've contracted to supply a thousand tonnes to Tesco's, that they have a thousand tonnes to supply to Tesco's and the water is the insurance policy that makes that happens.

Int: In what way are farmers penalised? Would the supermarket then pay more to source from elsewhere and charge the difference to the contracted farmer?

L: As I understand it, although I am not directly linked to the supermarket, but having spoken to the guy who does onions, and he trades directly with supermarkets, so he is very close to them. He would say that basically, if he leaves the shelf empty, if he hasn't put [REDACTED] on their, he is fined to the value of the retail space. So if they were selling them at £3.50 per kilo, for every kilo that he should have put on the shelf that isn't there, they will fine him £3.50.

Int: That sounds like the supermarkets are not really bearing much risk...

L: None at all. And this is well outside the scope of this interview, but in a lot of instances, supermarkets, which is why they are so cash rich, will pick up a load of onions from me today, send them to you tomorrow, and pay me in 90 days time. When do you pay for your groceries?

Int: When you get them.

L: When you get them. Exactly. So they are sitting on that money for 90 days.

Int: Right.

L: Before they hand it to me.

Int: And by contrast it sounds in a way that farmers don't have, I don't know if this is correct, but, for example, my husband runs his own business and he always has a float to ensure that for a certain amount of time that the business can continue to run, but some farmers that I've spoken to have said that they don't really have a float in a monetary sense, instead they have a lot of land and they can use that to borrow money.

L: So their asset risks, they borrow, they work off of overdraft and borrow money a lot of the time. Our contract farming arrangements work a hundred percent on borrowed money. So basically all the inputs, you start off with a balance of 0 and a big overdraft facility, and you buy all your inputs and all your costs come out of that account, and the overdraft grows and grows and grows, and then you have some grain to sell, so you sell some grain and the overdraft reduces, and if you are lucky you end up in the black, and at the end of the year you come along and we get paid as a contractor and you get paid as a land owner and return the balance to 0 and then the cycle goes off again.

Int: Sounds like engaging in a strong, trusting relationship with your bank manager is quite important as well?

L: Yeah yeah. And agriculture deals in big sums of money. So. And there are businesses that deal in much bigger sums of money, but it is you know, we are classified as small businesses, but it's not unusual to get bills of a hundred thousand, two hundred thousand and they have to be dealt with.

Int: So it sounds like there's more financial risk at the door of the farmer than there is of other people within the supply chain?



L: So the farmer has two huge risks, one is price volatility, which is very difficult to do anything about because it is driven by supply and demand and in today's world, global supply and demand, so price volatility is one major, major risk, and the second risk, which you can hedge against price, but the second risk is the weather. And nobody's come up with a hedging mechanism for the weather yet alright?! But if I have a dry season, I use more water, and I protect my high value crops, but all my other crops have to take their chances, I couldn't physically do it. So that is an issue to this business, and going forward we'll have nearly enough water to do a lot of additional land, but then it's about the equipment and the resource to do it when it needs doing, so it is, it will be a long time before wheat and barley receive regular irrigation, but sugar beet could, that's a relatively high value crop that we could see a return on. And potatoes and carrots and all those things will continue to be the most important things, because even now we are contracted to do it, we take a contract on that says we will supply this amount of water and we are obliged to do so.

Int: So, moving on just quickly we've talked for quite a long time and I don't want to take up too much of your time, but it is really interesting.

L: No, you're alright.

Int: I haven't asked you anything about the specific application technologies that you use on farm.

L: On this farm there are quite a lot of physical obstacles in fields, so [REDACTED] has a history of small fields, lots of sporadic villages dotted about all over the place. In most fields you'll have a tree or a pond, you have to go around that, and to get electrical supplies to all these small villages there are an enormous amount of powerlines that run across, so the use of booms, particularly, doesn't work in this part of [REDACTED] very well. So we apply all our water using rain guns. The one thing with booms is, what we've found is, we've tried a boom on fields we could, and the infiltration rate is too slow, because you are putting water over a small distance, rather than with a rain gun your infiltration times are better. So there's a lot for rain guns but obviously the wastage is higher, you lose more to the atmosphere, and there is a potential for runoff. So what we've done with the runoff is our standard application ten years ago would have been 25 mm, our standard application now is 20 mm. That has almost eliminated runoff and we were kidding ourselves because we thought with putting 25 on, that was 25 mm of usable water, whereas in reality it was probably on 20 mm of usable water, so that's given us an efficiency and we are using that. We tend to play about with nozzle sizes and trajectory, all those sorts of things, to try and get more of it to hit the target. And with our new irrigation system we are able to maintain good pressure which makes everything work more efficiently and better, so that's where the efficiencies have come. Going forwards quite interested in trickle, but I think with the amount of invasive cultivation that we do for veg crops, trickle's not really... to put permanent trickle in doesn't work, and the cost of putting trickle down and... because it's only cheap if you can use it more than once, and most people tell me you can't. So, but trickle has a lot of fantastic attributes that going forward would be good, in things like sugarbeet crops, because it allows us fertigation, it allows us lots of other things that perhaps can elevate our yields, at the same time, protecting the environment. So there's a lot of work that needs to be done, and that is the ultimate efficiency, and if I come back to something I said five

minutes ago, if you stop growing vegetables that would all become possible. It's the vegetables in sense... even if you were growing wheat and you put a permanent trickle system in that laid under the field that just let water go all the time, because it's a shallow cultivation you wouldn't ever touch the irrigation system so you would just keep the moisture in the soil ideal for growing a crop of wheat, and you could elevate the yields quite significantly, but I'm too old to see that being implemented, because that's a long way off.

Int: And are there any other future irrigation application or scheduling options that you think are likely to be coming into use around here.

L: I think scheduling is an interesting one, and scheduling is something that with better weather forecasting and better mechanisms for scheduling, and even having the ability to perhaps use drone technology to measure canopy size so that transpiration rates can be monitored in line with basic weather recording to give you better models for the scheduling, in a way testing what's in the soil would become less important if you could accurately predict the size of the canopy and the transpiration rates because you've got a good canopy within the field, it would be a much better way of scheduling your water requirements.

Int: And at the moment when you are applying irrigation with a rain gun, does it just always, I mean, this is just probably quite a silly question, I mean is it just standard for the whole field, or are there situations where you can see that some areas need a bit more and some areas need less.

L: Right, in theory all our machines could be set up to zone applications through the field, and in reality, the mechanism at the moment for conveying that information from agronomist to operator, is not there. The technology is there to be able to do it, because we do it for other crops; for an agronomist to map which parts of the field need more water, and then download that onto a USB stick that you plug into the machine and that alters the rate as you go across the field. And certainly I'm working with a company and they've got something called a rain dancer, which is really just a monitoring programme at the moment, but they are looking going forward to having the capability because they know where the irrigator is at all times, to start being able to speed up and slow the hose reel down in order to alter the amount of water that they put on. And we've also worked with a company called [REDACTED] who have been doing monitoring fields for the amount of stone content with the view that perhaps where it is stonier it will have a greater water requirement. So those sorts of projects are out there. But it's quite an academic idea that is quite difficult to turn into a practical solution at the moment.

Int: Because you are getting very precise information but...

L: But the machiner is not really capable of doing that. If you think that a rain gun works in a 72 metre arc, so in a sense you can only alter it in a piece of ground which is 72 metres wide, so, and within that 72 metres if you have a bit there that's got lots of stone and a bit there that hasn't got

very much stone and a bit there that's got no stone at all, which one of those three zones do you use to set your parameters. So that all becomes a little bit too difficult. And at the end of the day, nobody wants to compromise the crop. The crop remains king at the end of this because you've got to grow the crop to the best of your ability, so it's not, I'm not saying it can't be done, it is where drone technology can start to help us, but you'd have to fly your crops once a week and you'd have to measure the biomass once a week and then run that, and where perhaps the technology let's itself down is that there isn't enough real time information to be able to make decisions like that ([snaps fingers]), and very often that's how decisions need to be made.

Int: Because one or two days time can be critical

L: Yes, so it's all about real-time information so you can make instant decisions, and that's probably, it's the time lag with the technology that maybe is holding it back. So there's an enormous amount of things out there which going forward can all improve the situation and people like me tend to look at where it can end up, and it can't get there quick enough, and that's part of the problem, because it really needs to come along in bite-size bits so that it can be tested and can be made to work properly, so patience. I've never had any of that! So there are lots of exciting things, drone technology, better monitoring of weather and that sort of stuff will undoubtedly influence how we use water, and probably we need to be more discerning about where we grow some of these crops. If we are looking at the good of mankind rather than the good of individual businesses, we should be growing these crops where they display the greatest amount of water efficiency, but if you are a light land farmer in [REDACTED], and the land you have is the land you have, and it's an important part of your business, that's not a decision you are going to make, so that's a long way off.

Int: And what about something like wastewater re-use. Do you think there's any potential for that?

L: I think, if you take this farmyard here we once talked about, there's probably 2 acres of concrete here, and roof space, and that would be somewhere where the water effectively disappears, and do you collect it and use that, and that is, on the face of it, that's a good idea.

Int: I guess that would be a very small amount.

L: It is a very small amount

Int: But more, thinking about waste water coming from sewage treatment works.

L: I think that all those sorts of things have the possibility, but erm I think that has an end-user problem. You know, the idea that your tomatoes or your lettuces have been irrigated with waste sewage water probably doesn't appeal does it?

Int: Supposedly all the water we drink has been through ten or fifteen people beforehand

L: Well, it's just a perception. In Spain they use a lot dirty water effectively for irrigating crops, and people rave about Spanish tomatoes because they've got more flavour. But I think that we should find ways of using it, whether it be via pasturising it or purifying it to a greater extent. I think that the problem comes with that at the point where you get contamination, it becomes a major problem, so you have to create protocols and mechanisms where you practically eliminate the chance of it, and a little bit like what I was saying about collecting water out of this farmyard, it was a little bit the same, the reason we didn't do it, wasn't because it wasn't a good idea, it was because there are tractors, there are diesel tanks, there are chemical stores all in this farmyard and if get pollution and you pump it into your reservoir, instead of having a small pollution incident, you suddenly have 10 million gallons of water you've got to get rid of. Doesn't work, so it poses too big a risk, and that's where the sewage water sits, exactly in that. But if you put it through a reed bed and then take clean water out of the bottom of a reed bed, that is drinkable water, there's no reason that it couldn't work.

Int: Well sewage treatment works pump out into rivers after they've cleaned the water...

L: I mean a lot of the water goes out to sea, I'm not quite sure exactly how that mechanism works, so if it's going into rivers, the chances are inadvertently we are already using it.

Int: If it was used more directly then it wouldn't be a case of that water being taken from the environment

L: But you would say that where agriculture is where the most active is where the population is the lowest, so in reality it may be not as big an issue. Probably what's a bigger issue with sewage is the nutrient value, the phosphate and all the other nutrients that effectively being pumped out into the water courses and into the sea, which actually would benefit the whole ecosystem by being put back onto the land, so there's definitely a bigger conversation there.

Int: So one final question, just to summarise, thinking about irrigation efficiency and the direction that farms move in by making these big investments in irrigation efficiency, does that make for a more resilient business and more broadly, does that make for a more resilient catchment in terms of water.

L: I think that if we look at the local community, so if the local farming business is successful and growing lots of high value crops it creates more employment and it creates more wealth within society, therefore it's an important part of... this farm employs probably 8 people directly onto the

farm, and probably in peak times there's 20 people here dealing with veg crops at various time, so it's creating a lot of employment, and the labour force doubles because of the vegetables, so that creates more wealth into the community, so that's very good, and it is, because we have in a lot of what we grow, huge price volatility, for this business, being able to lock down a particular section of the business in the veg business where we know we've got a fixed income for a fixed period of time, that actually gives tremendous stability to this business and that does allow us to employ people to do things that benefit the community, that benefit the people who work here, that benefit the family that own the estate, so water makes all that possible and if you remove the water you would make this estate into a poorer place.

Int: So farms are being driven to become more water efficient, but at the same time they can't really reduce their overall water use because they are worried about losing their headroom.

L: Yes, we have a contradiction here, a major contradiction, in how the regulations are going to be implemented around water use because the driver for protecting your water use is to use your water which drives inefficiency because you use the water to protect your license, you don't use the water because you need it, and that's a really really bad way of doing it. And possibly one of the issues we have with it is that if I look at our water consumption, in some years we use 100% of our licenses and in some years we use 10% of our license. When the EA look at it they are far more interested in the years we use 10% than they are the years we use 100%, and we need to find better ways of deciding what our needs are, and there are plenty of people out there who've got a lot more water than they need, and they never use it, and they should be targeted, but there are equally people out there that could use more water if they could get hold of it and that would improve their business efficiency and their cropping options. And they should be given more water, but at the moment, the mechanism is all about taking license back, there is no mechanism for giving people who need it, more license.

Int: So do you think that something like water trading might help in that respect?

L: Um, water-trading, aggregation within catchments, would be quite a useful... so if there are four boreholes in this catchment and only three of them are going to be used in any one season, then perhaps those three should be allowed to take the full license commitment of the catchment, rather than having to go through different metres, so there would lots of ways that that could be done, and it's about making sure that the people who need it have access to it, and to try and discourage people from using it because if they don't use it they lose it, and this phrase, "use it or lose it", which is definitely one that the Environment Agency are using, is counter-productive, because it is not driving efficiency, it's driving waste. And we've had conversations which we'd say, "we need to protect our license, we need to take more off our license". We don't really have too many problems because we are using most of our licenses quite well, but you know, we've just done a renewal on one, well it starts on the 1st March, and the generic letter that came out from the Environment Agency said they were going to reduce the licence by 20%. It didn't say, "we think you are not using enough water", it just said, "your license has been cut by 20%".

Int: And has it been?

L: No, we argued it and it's been left where it was, but on that farm we could actually have done with it being increased by 20%, because the amount of water availability is curtailing what we would like to grow there, so we are now looking at aggregation of that licence with another borehole that we control to see if they will get it, but it's under the ownership of two different people, and actually dealing with people is more difficult than dealing with the Environment Agency! But those are things that we should be able to do, just to improve the efficient use of it, and stop people using it just because, "if you don't use it, you lose it", because that's just madness.

Int: What kind of things did people do in response to that?

L: Well, they probably irrigate barley, they probably, where they perhaps should only be putting 15 or 20 mm on, they put 25 mm on, because it's, and then it ends up finding its way back into the river as silt. Just all those things, and it's not joined up. So it needs to be much more joined up, but it is this "use it or lose it" phrase which is driving bad practice, and the problem is if you put that into print it won't necessarily end up giving the right result, because very often government departments will then find ways of making it difficult to waste it without actually giving you the ability to use it more efficiently, so they won't put the whole situation right, so erm. I just sound like a grumpy old man.

Int: No you don't! It is something that has come up alot.

L: Yes, well, I think the use it or lose it is a really bad policy. The EA, the NFU, agriculture, all need to engage much more as adults. It needs to be a much more grown up conversation than that. We do have a genuine need for this water, it is driven by climate, if it is a wet year we don't need any water, and if it is a dry year we need lots, and just try and find ways. And ultimately, perhaps putting winter storage in, or putting more water storage in, makes that conversation a whole lot easier because agriculture's use of water is not then determined by the weather here and now, the rainfall that happens in 2018. It has prepared itself for the potential of a dry year, and therefore it does not impact on the resources in a dry year, because it has effectively created a bank account that becomes its resource, you know, it's full of water and we can use it, so singularly, I would think, that the greatest efficiency would come from having more storage so that people know their licenses are safe, and then they can use their water more responsibly. Because there's a cost of pumping it. Costs 10p a cubic metre to pump irrigation water.

Int: Okay, that's brilliant - thankyou very much.