WEBVTT

1 00:00:00.000 --> 00:00:01.529 <v Man>All right, go ahead.</v>

2 00:00:01.529 --> 00:00:02.997 <v ->Okay, we're waiting on everyone</v>

3 00:00:02.997 --> 00:00:06.240 nice to have you here after the spring break.

4 00:00:06.240 --> 00:00:08.080 So, I'll be very quick.

5 00:00:08.080 --> 00:00:10.330 So today we're very pleased

6 00:00:10.330 --> 00:00:13.480 to have Dr. Laura Kahn joining us.

7 00:00:13.480 --> 00:00:18.480 Dr. Kahn is a physician, policy researcher advocate also.

8 00:00:19.160 --> 00:00:21.820 In 2006 she published,

9 00:00:21.820 --> 00:00:25.780 Confronting Zoonoses, Linking Human and Veterinary Medicine

10 00:00:25.780 --> 00:00:27.670 in the CDC journal.

11 00:00:27.670 --> 00:00:30.350 And helped launch the One Health Initiative.

12 00:00:30.350 --> 00:00:33.150 So she's a co-founder of the One Health Initiative

13 00:00:34.050 --> 00:00:36.910 and a lecturer at the Princeton University.

14 00:00:36.910 --> 00:00:40.023 So without further ado, let's welcome Dr. Kahn.

15 00:00:41.400 --> 00:00:43.230 <v ->Well thank you so much Kai,</v>

16 00:00:43.230 --> 00:00:46.880 it's a pleasure for me to be with all of you,

17 00:00:46.880 --> 00:00:50.853 and, let me share my screen now.

18 00:00:51.718 --> 00:00:52.551 And,

19 00:00:53.700 --> 00:00:55.510 I have to apologize,

20 00:00:55.510 --> 00:00:58.390 I can try and go into presentation mode

21 00:00:58.390 --> 00:01:01.240 but oftentimes it freezes,

22 00:01:01.240 --> 00:01:04.673 but let me give it a shot and see if it works.

23 00:01:06.150 --> 00:01:07.930 So I'm going to talk with you

24 00:01:07.930 --> 00:01:10.233 a One Health analysis of food, safety and security,

25 00:01:10.233 --> 00:01:13.430 antimicrobial resistance and climate change

26 00:01:13.430 --> 00:01:18.407 in the 21st century, and yes, they are all connected.

27 00:01:19.700 --> 00:01:21.930 It's important for us to recognize

28 00:01:21.930 --> 00:01:25.740 that agriculture is the foundation of civilization.

29 00:01:25.740 --> 00:01:29.920 Climate change threatens agriculture and food security.

30 00:01:29.920 --> 00:01:33.620 Antimicrobials are the foundation of modern medicine,

31 00:01:33.620 --> 00:01:35.500 and antimicrobial resistance

32 00:01:35.500 --> 00:01:38.610 threatens antimicrobial use and food safety.

33 00:01:38.610 --> 00:01:43.610 And we need both if we want a modern advanced society.

34 00:01:45.060 --> 00:01:46.540 Just a few definitions.

35 00:01:46.540 --> 00:01:49.860 When I say food security I mean no hunger,

36 00:01:49.860 --> 00:01:53.410 and food safety means no foodborne illness.

37 00:01:53.410 --> 00:01:56.490 When I talk about antimicrobial resistance in this talk,

38 00:01:56.490 --> 00:01:58.660 I'm gonna focus on bacteria

39 00:01:58.660 --> 00:02:01.453 that are resistant to antibiotics.

40 00:02:03.020 --> 00:02:05.750 Now the One Health concept is very simply

41 00:02:05.750 --> 00:02:08.490 that human, animal, plant, environmental

42 00:02:08.490 --> 00:02:10.960 and ecosystem health are linked.

43 00:02:10.960 --> 00:02:13.590 And this concept provides a very useful framework

44 00:02:13.590 --> 00:02:15.870 for examining these complex issues

45 00:02:15.870 --> 00:02:18.840 such as those that I'm talking about today.

46 00:02:18.840 --> 00:02:21.080 And if we wanna develop effective policies

47 00:02:21.080 --> 00:02:23.160 to address these health threats,

48 00:02:23.160 --> 00:02:26.370 we must examine the root causes.

49 00:02:26.370 --> 00:02:29.460 And people interact with their environment every day

50 00:02:29.460 --> 00:02:33.540 by inhaling air, drinking water and other fluids,

51 00:02:33.540 --> 00:02:37.500 and eating the plants and animals that we call food.

52 00:02:37.500 --> 00:02:40.210 And I just wanna point out the One Health initiative website

53 00:02:40.210 --> 00:02:41.963 that my colleagues and I run.

54 00:02:43.490 --> 00:02:47.560 Now many people have tried to visualize

55 00:02:47.560 --> 00:02:49.580 the One Health concept,

56 00:02:49.580 --> 00:02:53.650 and some use intersecting circles

57 00:02:53.650 --> 00:02:58.650 with increasing coordination, communication, collaboration.

58 00:02:58.680 --> 00:03:01.670 Others have humans, animals, environments

59 00:03:01.670 --> 00:03:04.890 intersecting with One Health in the middle.

60 00:03:04.890 --> 00:03:09.240 The wildlife folks like to highlight wildlife health

61 00:03:09.240 --> 00:03:13.850 separate from domesticated animal health, and human health.

62 00:03:13.850 --> 00:03:17.170 And my colleagues in Sweden use an umbrella graphic

63 00:03:17.170 --> 00:03:21.360 that includes a lot of, but most importantly,

64 00:03:21.360 --> 00:03:26.280 zoonotic infections in one intersecting circle

65 00:03:26.280 --> 00:03:29.160 and comparative medicine and chronic diseases,

66 00:03:29.160 --> 00:03:32.850 translational medicine in the other.

67 00:03:32.850 --> 00:03:37.193 In this talk I'm going to focus on the zoonotic issues.

68 00:03:38.940 --> 00:03:43.600 Now, I visualize One Health as a multidimensional cube,

69 00:03:43.600 --> 00:03:47.680 a matrix, interdimensional matrix if you will.

70 00:03:47.680 --> 00:03:50.360 In one dimension are the One Health factors,

71 00:03:50.360 --> 00:03:54.690 humans, animals, plants, environments, and ecosystems.

72 00:03:54.690 --> 00:03:57.750 On another dimension, the complexity factors

73 00:03:57.750 --> 00:04:00.600 looking at providing scale, microbial,

74 00:04:00.600 --> 00:04:04.520 or cellular individual and population levels.

75 00:04:04.520 --> 00:04:06.130 And then you can have the political,

76 00:04:06.130 --> 00:04:09.940 social and economic factors along another dimension.

77 00:04:09.940 --> 00:04:12.990 And that can be represented by political borders,

78 00:04:12.990 --> 00:04:15.010 such as local, regional, national,

79 00:04:15.010 --> 00:04:17.240 or international and global.

80 00:04:17.240 --> 00:04:18.910 And there can be a fourth dimension

81 00:04:18.910 --> 00:04:21.760 which I'm not representing or trying to represent

82 00:04:21.760 --> 00:04:24.220 and that's the dimension of time,

83 00:04:24.220 --> 00:04:28.793 which can be in days, months, years, decades, or eras.

84 00:04:30.400 --> 00:04:33.130 Now you can squash the cube

85 00:04:33.130 --> 00:04:35.690 into a two dimensional framework,

86 00:04:35.690 --> 00:04:38.730 and then you can see the intersections

87 00:04:38.730 --> 00:04:41.890 between these different dimensions.

88 00:04:41.890 --> 00:04:45.010 And in this talk I'm going to define environments

89 00:04:45.010 --> 00:04:48.880 as the abiotic or the soil, water, air aspects

90 00:04:48.880 --> 00:04:51.170 of defined geographic areas,

91 00:04:51.170 --> 00:04:54.350 and ecosystems, the biotic interactions,

92 00:04:54.350 --> 00:04:57.330 the microbial, flora, and fauna,

93 00:04:57.330 --> 00:05:00.043 within defined geographic areas.

94 00:05:01.650 --> 00:05:05.140 So in this talk then we're to do a One Health analysis

95 00:05:05.140 --> 00:05:08.750 looking at different factors, One Health factors,

96 00:05:08.750 --> 00:05:10.600 complexity factors,

97 00:05:10.600 --> 00:05:13.330 and following it up with the political, social,

98 00:05:13.330 --> 00:05:18.173 and economic factors, just a brief, touching on that.

99 00:05:19.560 --> 00:05:20.393 So in other words

100 00:05:20.393 --> 00:05:24.463 let's do a One Health satellite perspective on these issues.

101 00:05:25.430 --> 00:05:27.920 Our first analysis.

102 00:05:27.920 --> 00:05:31.560 We have almost 8 billion humans on the planet.

103 00:05:31.560 --> 00:05:35.920 And according to the UN Food and Agriculture Organization,

104 00:05:35.920 --> 00:05:40.690 we have around 30 billion terrestrial food animals.

105 00:05:40.690 --> 00:05:44.900 And as the famous children's book author, Taro Gomi writes,

106 00:05:44.900 --> 00:05:49.160 all animals eat, so everyone poops.

107 00:05:49.160 --> 00:05:51.610 And indeed, according to this paper

108 00:05:51.610 --> 00:05:55.880 published by David Berendes in Nature Sustainability,

109 00:05:55.880 --> 00:05:59.220 published in 2018, they estimate that humans

110 00:05:59.220 --> 00:06:01.970 and their domesticated food animals

111 00:06:01.970 --> 00:06:04.360 produce around 4 trillion kilograms

112 00:06:04.360 --> 00:06:06.810 of fecal matter each year,

113 00:06:06.810 --> 00:06:09.390 and that is increasing.

114 00:06:09.390 --> 00:06:14.320 And to just put it into perspective on how much that is,

115 00:06:14.320 --> 00:06:17.980 4 trillion kilograms would fill over 1.6 million

116 00:06:17.980 --> 00:06:20.420 Olympic size swimming pools,

117 00:06:20.420 --> 00:06:24.020 or to put it another way, to bury the entire surface areas

118 00:06:24.020 --> 00:06:27.383 of Los Angeles and New York in six feet of feces,

119 00:06:28.530 --> 00:06:30.343 which is a lot of fecal matter.

120 00:06:32.320 --> 00:06:34.833 If you look at just human fecal matter,

121 00:06:35.960 --> 00:06:38.980 lot of people ares still defecating outdoors,

122 00:06:38.980 --> 00:06:40.590 called open defecation

123 00:06:40.590 --> 00:06:45.590 around 673 million, according to Statista, oops.

124 00:06:48.250 --> 00:06:52.050 A lot of these people are in developing countries

125 00:06:52.050 --> 00:06:56.790 in Sub-Saharan Africa and south Asia and south America.

126 00:06:56.790 --> 00:06:59.130 A lot of people people don't have access

127 00:06:59.130 --> 00:07:00.840 to basic sanitation.

128 00:07:00.840 --> 00:07:05.280 And so they use open fields,

129 00:07:05.280 --> 00:07:08.020 which has health, environmental

130 00:07:08.020 --> 00:07:11.233 and human health consequences.

131 00:07:13.040 --> 00:07:17.420 Animals use open defecation all the time.

132 00:07:17.420 --> 00:07:18.700 I mean there's,

133 00:07:18.700 --> 00:07:21.870 sanitation systems are designed to process

134 00:07:21.870 --> 00:07:24.313 human fecal matter, they do not,

135 00:07:25.493 --> 00:07:30.493 they're not designed to process animal fecal matter.

136 00:07:31.040 --> 00:07:33.810 And there's very little research actually done

137 00:07:33.810 --> 00:07:35.680 on all the animal fecal matter.

138 00:07:35.680 --> 00:07:37.070 Now it's important to point out

139 00:07:37.070 --> 00:07:40.110 that 4 trillion kilograms of fecal matter that we produce,

140 00:07:40.110 --> 00:07:43.800 80% of it comes from animals.

141 00:07:43.800 --> 00:07:47.930 Very little study, this one study done in 2014

142 00:07:47.930 --> 00:07:49.303 in the Netherlands,

143 00:07:50.430 --> 00:07:52.730 looked at 34 countries

144 00:07:52.730 --> 00:07:56.823 to see if they had policies related to manure management.

145 00:07:58.090 --> 00:08:01.920 30 of them did, but, having legislation

146 00:08:01.920 --> 00:08:04.300 on what to do with all this fecal matter is one thing,

147 00:08:04.300 --> 00:08:07.180 but actually enforcing it is another.

148 00:08:07.180 --> 00:08:11.040 And most of these countries have weak enforcement

149 00:08:11.040 --> 00:08:13.283 on manure management.

150 00:08:14.690 --> 00:08:19.240 Now this is an issue that is not solely a problem

151 00:08:19.240 --> 00:08:23.810 for poor or developing countries, wealthy countries,

152 00:08:23.810 --> 00:08:25.310 such as the United States

153 00:08:25.310 --> 00:08:29.620 have large concentrated animal feeding operations

154 00:08:29.620 --> 00:08:34.300 that have hundreds, thousands, tens of thousands of animals

155 00:08:34.300 --> 00:08:38.150 being raised in enclosed concentrated areas,

156 00:08:38.150 --> 00:08:41.070 and they're producing a lot of fecal matter.

157 00:08:41.070 --> 00:08:45.220 And indeed this one study, the latest one, 2008,

158 00:08:45.220 --> 00:08:48.210 the U.S. Government Accountability Office,

159 00:08:48.210 --> 00:08:50.440 found that there's no federal agency

160 00:08:50.440 --> 00:08:55.400 that consistently collects reliable data on these CAFOs,

161 00:08:55.400 --> 00:08:58.130 but they did find that some large operations

162 00:08:58.130 --> 00:09:03.130 can produce more than 1.6 million tons of manure a year.

163 00:09:05.580 --> 00:09:08.970 Some that can generate more raw waste

164 00:09:08.970 --> 00:09:11.660 than some U.S. cities produce annually.

165 00:09:11.660 --> 00:09:16.660 So, this is a major issue that's just not being discussed.

166 00:09:17.840 --> 00:09:21.640 There's a lot of pathogens in human fecal matter,

167 00:09:21.640 --> 00:09:24.140 I'm not going to go into the detail

168 00:09:24.140 --> 00:09:25.910 of all of these pathogens,

169 00:09:25.910 --> 00:09:30.330 but, just as there's lots of pathogens in human feces,

170 00:09:30.330 --> 00:09:33.660 there's lots of pathogens in animal feces,

171 00:09:33.660 --> 00:09:38.140 but again, very few studies examining these pathogens

172 00:09:38.140 --> 00:09:40.570 in animal feces, and few studies

173 00:09:40.570 --> 00:09:43.880 looking at their health implications

174 00:09:44.760 --> 00:09:49.440 on, foodborne pathogens, waterborne pathogens,

175 00:09:49.440 --> 00:09:53.693 or just a direct contamination of people.

176 00:09:55.800 --> 00:09:59.240 Nevertheless, in 2015, the World Health Organization

177 00:09:59.240 --> 00:10:00.930 released a report estimating

178 00:10:00.930 --> 00:10:03.380 the global burden of foodborne illness.

179 00:10:03.380 --> 00:10:06.910 They estimate that around 600 million people get sick,

180 00:10:06.910 --> 00:10:09.930 around 420,000 die.

181 00:10:09.930 --> 00:10:14.010 Children under the age of five makeup 40% of the cases.

182 00:10:14.010 --> 00:10:15.643 But most importantly,

183 00:10:17.380 --> 00:10:18.720 most of these illnesses

184 00:10:18.720 --> 00:10:22.760 are due to diarrhea disease agents.

185 00:10:22.760 --> 00:10:25.800 And most of these diarrhea disease agents

186 00:10:25.800 --> 00:10:28.300 are in fecal matter.

187 00:10:28.300 --> 00:10:33.300 Many of them in animal fecal matter.

188 00:10:33.680 --> 00:10:36.343 Sorry, it's problematic.

189 00:10:38.340 --> 00:10:41.197 Again, we focus primarily on human fecal matter

190 00:10:41.197 --> 00:10:44.770 and the sanitation systems that either do or don't exist,

191 00:10:44.770 --> 00:10:47.730 but nobody's talking about all of this animal fecal matter

192 00:10:47.730 --> 00:10:50.760 in the environment that's contaminating our food,

193 00:10:50.760 --> 00:10:55.760 our water, and the people living in those environ,

194 00:10:56.150 --> 00:10:57.713 making the people sick.

195 00:10:59.290 --> 00:11:03.620 So that now brings me to this second One Health analysis

196 00:11:03.620 --> 00:11:05.493 looking at plants.

197 00:11:06.480 --> 00:11:09.710 So the world has over 50,000 edible plants,

198 00:11:09.710 --> 00:11:12.570 but just three of them, rice, maize, and wheat

199 00:11:12.570 --> 00:11:16.113 provide 60% of the world's food energy intake.

200 00:11:16.970 --> 00:11:19.460 And these plants have health needs

201 00:11:20.480 --> 00:11:23.410 what's relevant in our discussion today

202 00:11:23.410 --> 00:11:28.410 are the macronutrients, nitrogen, phosphorus, and potassium.

203 00:11:30.530 --> 00:11:34.750 Now in 1944, Norman Borlaug, pictured here

204 00:11:34.750 --> 00:11:36.600 who was a plant pathologist,

205 00:11:36.600 --> 00:11:38.810 worked for the Rockefeller Foundation

206 00:11:38.810 --> 00:11:41.710 to try to improve wheat harvest

207 00:11:41.710 --> 00:11:44.512 because a lot of the wheat crops

208 00:11:44.512 --> 00:11:47.210 were dying from disease

209 00:11:47.210 --> 00:11:52.210 and there were problematic growing conditions.

210 00:11:52.440 --> 00:11:55.460 So he developed some new wheat varieties

211 00:11:55.460 --> 00:11:58.260 and new crop management practices,

212 00:11:58.260 --> 00:12:02.410 which spread from Mexico to Asia and south America,

213 00:12:02.410 --> 00:12:05.820 and this was known as the Green Revolution.

214 00:12:05.820 --> 00:12:08.350 And the Green Revolution was tremendous

215 00:12:08.350 --> 00:12:12.130 in staving off famine for much of the world,

216 00:12:12.130 --> 00:12:13.720 and you can see in these graphs

217 00:12:13.720 --> 00:12:16.440 that for the same amount of land

218 00:12:16.440 --> 00:12:19.800 that was being used to grow the crops,

219 00:12:19.800 --> 00:12:24.800 the yields just took off, and it was just amazing.

220 00:12:26.960 --> 00:12:28.120 And you can see here

221 00:12:28.120 --> 00:12:32.453 the serial yield in some countries are very high.

222 00:12:33.880 --> 00:12:37.760 However, there were problems with the Green Revolution.

223 00:12:37.760 --> 00:12:40.830 Intensive farming practices that were needed

224 00:12:40.830 --> 00:12:44.670 for this intensive yield from the land

225 00:12:44.670 --> 00:12:47.703 led to soil erosion, water shortages,

226 00:12:48.880 --> 00:12:52.200 micronutrient deficiencies in the soil,

227 00:12:52.200 --> 00:12:56.090 a dependency on high nitrogen synthetic fertilizers

228 00:12:56.090 --> 00:12:57.990 which we'll get to more in a minute.

229 00:12:57.990 --> 00:13:02.990 Vulnerability to pests and a high need for pesticides.

230 00:13:03.230 --> 00:13:07.620 And because these crops were genetically engineered,

231 00:13:07.620 --> 00:13:11.480 they were labeled genetically modified organisms

232 00:13:11.480 --> 00:13:14.623 which could lead to political opposition.

233 00:13:15.880 --> 00:13:20.880 Now in 1961, 1.5 times more animal manure

234 00:13:21.634 --> 00:13:25.660 was used as fertilizer than synthetic fertilizer,

235 00:13:25.660 --> 00:13:30.200 but because of the Green Revolution now in 20,

236 00:13:30.200 --> 00:13:34.360 in the late, in 2019 and onwards,

237 00:13:34.360 --> 00:13:36.730 four times more synthetic fertilizer

238 00:13:36.730 --> 00:13:39.493 now is being used than manure.

239 00:13:41.250 --> 00:13:44.523 And if manure is not being used as fertilizer

240 00:13:44.523 --> 00:13:45.680 then we have to ask,

241 00:13:45.680 --> 00:13:47.320 well, what's being done with it?

242 00:13:47.320 --> 00:13:49.810 Because again, we're producing

243 00:13:49.810 --> 00:13:52.300 4 trillion kilograms of fecal matter,

244 00:13:52.300 --> 00:13:54.870 80% of which is from animals.

245 00:13:54.870 --> 00:13:56.980 And if it's not being used as fertilizer,

246 00:13:56.980 --> 00:13:58.593 than what's being done with it?

247 00:13:59.550 --> 00:14:02.570 Now, there are some advantages to using manure

248 00:14:02.570 --> 00:14:06.380 as fertilizer, because it does help renew,

249 00:14:06.380 --> 00:14:10.840 to nourish the soil that you don't necessarily get

250 00:14:10.840 --> 00:14:13.253 with the high nitrogen fertilizers.

251 00:14:14.523 --> 00:14:17.680 And that brings me now to my third One Health analysis,

252 00:14:17.680 --> 00:14:20.190 looking at environments and ecosystems.

253 00:14:20.190 --> 00:14:23.130 And you'll see where I'm coming,

254 00:14:23.130 --> 00:14:28.010 it will kind of all tie together with this section.

255 00:14:29.340 --> 00:14:32.140 Now, climate change threatens agriculture,

256 00:14:32.140 --> 00:14:36.090 and agriculture worsens climate change.

257 00:14:36.090 --> 00:14:39.070 And in order to truly understand climate change

258 00:14:39.070 --> 00:14:42.090 we need to think like geologists.

259 00:14:42.090 --> 00:14:45.270 And we need to look at the geologic timeline

260 00:14:45.270 --> 00:14:47.660 of the temperature of the planet.

261 00:14:47.660 --> 00:14:50.670 If we look at the Paleozoic era,

262 00:14:50.670 --> 00:14:53.110 yes, the planet was very hot,

263 00:14:53.110 --> 00:14:54.870 but it's important to point out

264 00:14:54.870 --> 00:14:58.613 that the land was barren because it was hot,

265 00:14:58.613 --> 00:15:02.760 and there was thriving life in the seas.

266 00:15:02.760 --> 00:15:07.560 We definitely do not wanna get back to this level of heat

267 00:15:07.560 --> 00:15:09.460 on our planet.

268 00:15:09.460 --> 00:15:11.970 With time, the planet began to cool,

269 00:15:11.970 --> 00:15:13.740 you get to the Pliocene era,

270 00:15:13.740 --> 00:15:18.500 and then the Pleistocene era, which was the ice age.

271 00:15:18.500 --> 00:15:21.250 Now, the planet, much of the planet

272 00:15:21.250 --> 00:15:25.123 was covered in thick layers of ice, humans did exist.

273 00:15:26.680 --> 00:15:29.170 Their survival was tenuous.

274 00:15:29.170 --> 00:15:34.130 And then inexplicably, around 10,000 years ago,

275 00:15:34.130 --> 00:15:37.490 the planet began to warm.

276 00:15:37.490 --> 00:15:38.940 The ice age ended

277 00:15:39.869 --> 00:15:43.640 and you get to the beginning of the Holocene.

278 00:15:43.640 --> 00:15:46.280 Now, so for the past 10,000 years,

279 00:15:46.280 --> 00:15:49.280 and this is sorry,

280 00:15:49.280 --> 00:15:52.010 this is when agriculture was developed

281 00:15:52.010 --> 00:15:53.630 about 10,000 years ago.

282 00:15:53.630 --> 00:15:55.300 And the reason why it could develop

283 00:15:55.300 --> 00:15:58.760 was because the planet was warm enough to allow it.

284 00:15:58.760 --> 00:16:02.280 So, when we talk about climate change,

285 00:16:02.280 --> 00:16:06.030 it means change from this Holocene baseline

286 00:16:06.030 --> 00:16:10.760 that has allowed agriculture and civilization to exist.

287 00:16:10.760 --> 00:16:13.490 Now, there was a little deviation

288 00:16:13.490 --> 00:16:15.210 below the Holocene baseline,

289 00:16:15.210 --> 00:16:18.000 and that was the little ice age.

290 00:16:18.000 --> 00:16:21.140 We have now gone up about one degree

291 00:16:21.140 --> 00:16:23.550 above this Holocene baseline,

292 00:16:23.550 --> 00:16:27.093 and we're starting to see the effects of climate change.

293 00:16:27.990 --> 00:16:31.240 Now the artists from, during the little ice age

294 00:16:31.240 --> 00:16:34.230 documented for us what it looked like.

295 00:16:34.230 --> 00:16:36.720 You had a lot of frozen,

296 00:16:36.720 --> 00:16:41.590 the Thames froze over in Britain, and they had frost fairs.

297 00:16:41.590 --> 00:16:45.180 They had frozen wasteland and Flanders ice skating

298 00:16:45.180 --> 00:16:47.690 on the main canal in Rotterdam.

299 00:16:47.690 --> 00:16:48.780 But most importantly,

300 00:16:48.780 --> 00:16:51.410 the little ice age was noted for crop failures,

301 00:16:51.410 --> 00:16:54.160 bread, riots, famine, and wars.

302 00:16:54.160 --> 00:16:58.960 So, when food security breaks down,

303 00:16:58.960 --> 00:17:03.960 so does civil society and you wind up with wars.

304 00:17:04.030 --> 00:17:05.653 And it's a very ugly,

305 00:17:06.790 --> 00:17:08.990 ugly situation indeed,

306 00:17:08.990 --> 00:17:12.063 one that we want to avoid at all costs.

307 00:17:13.590 --> 00:17:18.130 Now in 2010 the World Bank did some climate modeling,

308 00:17:18.130 --> 00:17:21.470 estimating agricultural yields in 2050

309 00:17:21.470 --> 00:17:23.610 due to climate change effects.

310 00:17:23.610 --> 00:17:27.790 Assuming current agricultural practices and crop varieties.

311 00:17:27.790 --> 00:17:29.880 And they determined that much of the planet

312 00:17:29.880 --> 00:17:33.920 is going to become too hot and too dry to grow food.

313 00:17:33.920 --> 00:17:36.130 And as again, as we said,

314 00:17:36.130 --> 00:17:40.149 we're already starting to see the impact of this.

315 00:17:40.149 --> 00:17:45.130 But even with that situation, even today though,

316 00:17:45.130 --> 00:17:49.300 we still have a lot of food insecurity, a lot of hunger,

317 00:17:49.300 --> 00:17:52.840 particularly in poor developing countries

318 00:17:52.840 --> 00:17:57.760 like Sub-Saharan Africa, south Asia, south America,

319 00:17:57.760 --> 00:17:59.510 but even in the United States

320 00:17:59.510 --> 00:18:02.690 where the color is a monolithic blue,

321 00:18:02.690 --> 00:18:05.730 we have a lot of food insecurity here as well.

322 00:18:05.730 --> 00:18:09.010 So, this is a major issue

323 00:18:09.010 --> 00:18:14.010 that, one that really needs to get much more attention

324 00:18:14.053 --> 00:18:16.113 than it's getting.

325 00:18:17.690 --> 00:18:21.030 Now that brings me to greenhouse gases.

326 00:18:21.030 --> 00:18:24.230 Because manure and synthetic fertilizer

327 00:18:24.230 --> 00:18:26.110 emit greenhouse gases.

328 00:18:26.110 --> 00:18:28.590 In fact, they're major emitters of methane

329 00:18:28.590 --> 00:18:30.630 and nitrous oxide.

330 00:18:30.630 --> 00:18:34.570 Now, if we use carbon dioxide as the baseline,

331 00:18:34.570 --> 00:18:38.320 methane is about 28 times more potent

332 00:18:38.320 --> 00:18:41.560 than carbon dioxide at trapping heat,

333 00:18:41.560 --> 00:18:45.510 and nitrous oxide is about 265 times

334 00:18:45.510 --> 00:18:48.920 more potent at trapping heat than carbon dioxide.

335 00:18:48.920 --> 00:18:53.630 So these are greenhouse gases that are extremely potent

336 00:18:53.630 --> 00:18:55.693 and should be of major concern.

337 00:18:58.342 --> 00:19:00.880 I just wanna point out that basically

338 00:19:00.880 --> 00:19:03.000 these greenhouse gases that we're burning

339 00:19:03.000 --> 00:19:05.440 are decomposed plants and animals,

340 00:19:05.440 --> 00:19:10.120 pressure, heat, and time, produce coal, petroleum, gas.

341 00:19:10.120 --> 00:19:14.590 So we're just burning old, dead animals and plants

342 00:19:14.590 --> 00:19:16.030 up into the atmosphere.

343 00:19:16.030 --> 00:19:20.543 And that's what the fossil fuels basically are made from.

344 00:19:21.950 --> 00:19:26.200 In terms of what we in the United States emit

345 00:19:26.200 --> 00:19:30.550 according to the U.S. Environmental Protection Agency,

346 00:19:30.550 --> 00:19:35.350 we emit about 17% of our greenhouse gases

347 00:19:35.350 --> 00:19:37.453 are methane and nitrous oxide.

348 00:19:38.780 --> 00:19:41.610 Of the different economic sectors,

349 00:19:41.610 --> 00:19:46.523 agriculture produces about 10% of the greenhouse gases.

350 00:19:47.720 --> 00:19:49.550 But most importantly,

351 00:19:49.550 --> 00:19:53.830 if you look at the sources of methane and nitrous oxide,

352 00:19:53.830 --> 00:19:57.980 manure management produces 9% of methane,

353 00:19:57.980 --> 00:20:02.244 Enteric fermentation a whopping 27%.

354 00:20:02.244 --> 00:20:05.538 Nitrous oxide, manure management 4%,

355 00:20:05.538 --> 00:20:10.538 and a whopping 78% of agricultural soil management

356 00:20:10.980 --> 00:20:13.333 produces nitrous oxides.

357 00:20:14.410 --> 00:20:18.850 So in other words, Enteric fermentation, manure,

358 00:20:18.850 --> 00:20:22.400 and the use of high nitrogen fertilizer,

359 00:20:22.400 --> 00:20:24.140 agricultural soil management,

360 00:20:24.140 --> 00:20:28.370 major emitters of the most potent greenhouse gases

361 00:20:28.370 --> 00:20:29.913 that are trapping heat.

362 00:20:30.838 --> 00:20:33.920 Now you might ask, "Well, what is Enteric fermentation?"

363 00:20:33.920 --> 00:20:37.320 Well, cattle have four chambered stomachs,

364 00:20:37.320 --> 00:20:39.568 one of which is called the rumen,

365 00:20:39.568 --> 00:20:43.320 and it acts as a fermenter of the feeds,

366 00:20:43.320 --> 00:20:45.410 and that produces methane.

367 00:20:45.410 --> 00:20:48.440 And, when this methane builds up,

368 00:20:48.440 --> 00:20:50.700 the cow burps and releases it.

369 00:20:50.700 --> 00:20:53.460 And if you've got a lot of ruminants,

370 00:20:53.460 --> 00:20:54.860 you've got a lot of methane.

371 00:20:56.110 --> 00:21:01.070 Different animals produce different levels of methane,

372 00:21:01.070 --> 00:21:05.510 the beef, the ruminants, beef, dairy, and Buffalo

373 00:21:05.510 --> 00:21:08.910 produce a lot of enteric methane.

374 00:21:08.910 --> 00:21:11.260 Chickens not so much.

375 00:21:11.260 --> 00:21:14.120 Goats are ruminants, they also produce methane

376 00:21:14.120 --> 00:21:16.460 as do sheep but not pigs.

377 00:21:16.460 --> 00:21:21.460 So, chickens are probably more environmentally friendly

378 00:21:22.820 --> 00:21:24.743 than your average ruminant.

379 00:21:26.960 --> 00:21:30.140 Let's now shift gears and move from environments

380 00:21:30.140 --> 00:21:35.140 to ecosystems and talk a bit about antimicrobial resistance.

381 00:21:35.990 --> 00:21:40.990 Remember, it threatens the practice of modern medicine.

382 00:21:41.010 --> 00:21:42.250 Oops.

383 00:21:42.250 --> 00:21:45.470 And it turns out that any microbial resistance

384 00:21:45.470 --> 00:21:47.600 is ancient in everywhere.

385 00:21:47.600 --> 00:21:49.710 For a long time to people thought that,

386 00:21:49.710 --> 00:21:51.500 or scientists thought that

387 00:21:51.500 --> 00:21:55.320 microbes used antibiotics as a form of chemical warfare

388 00:21:55.320 --> 00:21:56.270 against each other.

389 00:21:56.270 --> 00:22:00.020 But it turns out it appears that they use minute amounts

390 00:22:00.020 --> 00:22:02.120 as a form of communication with each other

391 00:22:02.120 --> 00:22:04.380 which is a very different thing.

392 00:22:04.380 --> 00:22:06.940 And using metagenomics,

393 00:22:06.940 --> 00:22:10.130 where you extract DNA or genetic material

394 00:22:10.130 --> 00:22:12.300 directly from the soil,

395 00:22:12.300 --> 00:22:15.580 they have found resistance genes everywhere in the Arctic,

396 00:22:15.580 --> 00:22:18.980 in the Antarctic and places that have never seen

397 00:22:18.980 --> 00:22:21.560 anthropogenic exposure.

398 00:22:21.560 --> 00:22:25.550 And so we're dealing with a much bigger issue

399 00:22:25.550 --> 00:22:29.470 than we originally believed.

400 00:22:29.470 --> 00:22:33.860 This isn't something that is just due to our practice.

401 00:22:33.860 --> 00:22:35.350 This is preexisting,

402 00:22:35.350 --> 00:22:39.050 and our massive use of antibiotics in humans,

403 00:22:39.050 --> 00:22:41.660 in animals, on crops,

404 00:22:41.660 --> 00:22:45.900 is increasing the expression of these resistance genes

405 00:22:45.900 --> 00:22:48.690 and the bacteria are sharing them with each other

406 00:22:48.690 --> 00:22:52.410 much faster than we can develop new antimicrobials.

407 00:22:52.410 --> 00:22:57.123 So, we are working against nature and we're going to lose.

408 00:22:58.350 --> 00:23:01.850 So, how are we adversely impacting the global resistome?

409 00:23:01.850 --> 00:23:06.050 Again, poor sanitation leading to foodborne

410 00:23:06.050 --> 00:23:10.170 waterborne illnesses from all the manure in our environment.

411 00:23:10.170 --> 00:23:12.650 Indiscriminate and antibiotic use.

412 00:23:12.650 --> 00:23:15.170 Untreated human and animal waste.

413 00:23:15.170 --> 00:23:17.830 Land and water contamination.

414 00:23:17.830 --> 00:23:21.870 And then the wildlife spread these resistance genes as well.

415 00:23:21.870 --> 00:23:24.040 All of them together conspire

416 00:23:24.040 --> 00:23:27.863 to worsen antimicrobial resistance.

417 00:23:29.230 --> 00:23:31.760 Manure, particularly animal manure

418 00:23:31.760 --> 00:23:34.050 also can serve as a potential hotspot

419 00:23:34.050 --> 00:23:39.050 for microbes to share resistance genes with each other.

420 00:23:40.010 --> 00:23:42.893 So again, the manure connection.

421 00:23:44.847 --> 00:23:47.980 So let's now quickly go to the fourth analysis,

422 00:23:47.980 --> 00:23:52.550 looking at this political, social and economic factors.

423 00:23:52.550 --> 00:23:56.960 Food security is the foundation of civilization.

424 00:23:56.960 --> 00:24:01.270 It means no hungry people, and it's built on three pillars.

425 00:24:01.270 --> 00:24:03.510 Food availability, food access,

426 00:24:03.510 --> 00:24:07.193 or affordability, and food use food.

427 00:24:07.193 --> 00:24:09.200 Food security is so important

428 00:24:09.200 --> 00:24:12.680 that the UN listed it as number two

429 00:24:12.680 --> 00:24:14.710 of its sustainable development goals

430 00:24:14.710 --> 00:24:16.373 in terms of zero hunger.

431 00:24:17.633 --> 00:24:22.633 There are political implications of food insecurity.

432 00:24:22.970 --> 00:24:26.210 If food becomes unavailable or too expensive,

433 00:24:26.210 --> 00:24:29.710 civil society breaks down and people riot.

434 00:24:29.710 --> 00:24:32.750 So it's in government's interest

435 00:24:32.750 --> 00:24:36.443 to make sure that their people have enough food to eat.

436 00:24:38.020 --> 00:24:41.230 Now, there are countries that eat a lot more meat

437 00:24:41.230 --> 00:24:44.600 than other countries, particularly the United States.

438 00:24:44.600 --> 00:24:47.330 We are one of the highest consumers in the world,

439 00:24:47.330 --> 00:24:51.170 so we are in no moral position to tell anybody else

440 00:24:51.170 --> 00:24:53.700 what they can or cannot eat.

441 00:24:53.700 --> 00:24:57.870 But, eating meat is the norm in most countries,

442 00:24:57.870 --> 00:25:00.590 with one exception, India,

443 00:25:00.590 --> 00:25:03.900 where they have the largest fraction of vegetarians

444 00:25:03.900 --> 00:25:05.170 in the world.

445 00:25:05.170 --> 00:25:09.430 But even in India, demand for animal proteins

446 00:25:09.430 --> 00:25:12.663 such as Buffalo milk is increasing.

447 00:25:14.370 --> 00:25:18.100 It is possible to change national dietary preferences

448 00:25:18.100 --> 00:25:19.650 but it's not easy

449 00:25:19.650 --> 00:25:23.570 and it requires cultural and societal change.

450 00:25:23.570 --> 00:25:27.680 In the U.S. more Americans are cutting back on meat.

451 00:25:27.680 --> 00:25:30.580 Some of the reasons are concerns about their health,

452 00:25:30.580 --> 00:25:32.800 or the environment.

453 00:25:32.800 --> 00:25:36.170 But again, this is not an easy thing to do

454 00:25:36.170 --> 00:25:37.800 and you can't force people

455 00:25:37.800 --> 00:25:41.860 to demand that they all become vegetarian

456 00:25:41.860 --> 00:25:45.950 because it's, you know, eating meat is ingrained

457 00:25:45.950 --> 00:25:50.950 in many of our societal functions and religions.

458 00:25:51.792 --> 00:25:56.203 It's not, again, not an easy thing to change.

459 00:25:57.600 --> 00:26:01.530 So now a recap on our findings.

460 00:26:01.530 --> 00:26:04.830 Humans and domesticated animal populations are growing

461 00:26:04.830 --> 00:26:09.090 and producing increasing amounts of fecal matter each year.

462 00:26:09.090 --> 00:26:11.400 Animals produce 80% of it,

463 00:26:11.400 --> 00:26:13.880 but it's generally ignored.

464 00:26:13.880 --> 00:26:17.030 Human and animal fecal matter contain many pathogens,

465 00:26:17.030 --> 00:26:20.060 but sanitation systems are designed

466 00:26:20.060 --> 00:26:24.090 to process human fecal matter, not animal fecal matter.

467 00:26:24.090 --> 00:26:26.070 So the question is what's being done

468 00:26:26.070 --> 00:26:30.820 with all of this animal fecal matter produced in CAFOs,

469 00:26:30.820 --> 00:26:32.640 and in countries around the world?

470 00:26:32.640 --> 00:26:34.950 There's little oversight of it.

471 00:26:34.950 --> 00:26:39.430 Now plants need nitrogen, phosphorus, and potassium to grow

472 00:26:39.430 --> 00:26:41.900 which is contained in manure,

473 00:26:41.900 --> 00:26:44.683 but synthetic fertilizer uses predominates,

474 00:26:47.034 --> 00:26:49.240 and of course, all of this manure

475 00:26:49.240 --> 00:26:52.010 and this high nitrogen fertilizer

476 00:26:52.010 --> 00:26:54.760 is emitting methane and nitrous oxide

477 00:26:54.760 --> 00:26:57.530 which are potent greenhouse gases,

478 00:26:57.530 --> 00:26:59.870 worsening climate change.

479 00:26:59.870 --> 00:27:03.210 Manures also contaminating the global resistome

480 00:27:03.210 --> 00:27:06.800 which worsens antimicrobial resistance.

481 00:27:06.800 --> 00:27:08.453 And all of these together,

482 00:27:09.420 --> 00:27:11.640 these findings impact food safety

483 00:27:11.640 --> 00:27:14.750 in the practice of medicine, and food security

484 00:27:14.750 --> 00:27:18.463 and the continuation of agriculture and civilization.

485 00:27:19.590 --> 00:27:22.477 So you might be asking, "Well, what can be done?"

486 00:27:23.700 --> 00:27:28.680 Well in 2016, the UN General Assembly met

487 00:27:28.680 --> 00:27:32.873 to deliberate on antimicrobial resistance.

488 00:27:34.070 --> 00:27:38.090 They agreed that this is a crisis

489 00:27:38.090 --> 00:27:40.860 and requires political solutions,

490 00:27:40.860 --> 00:27:44.920 and tasked the World Health Assembly

491 00:27:44.920 --> 00:27:47.160 and the World Health Organization

492 00:27:47.160 --> 00:27:50.063 to develop global action plan.

493 00:27:51.490 --> 00:27:53.750 The global action plan that they developed

494 00:27:53.750 --> 00:27:57.390 to serve as a model for all nations to use.

495 00:27:57.390 --> 00:27:59.760 One of which had objective three,

496 00:27:59.760 --> 00:28:02.150 to reduce the incidence of infection

497 00:28:02.150 --> 00:28:04.130 through effective sanitation,

498 00:28:04.130 --> 00:28:07.230 hygiene and infection prevention measures.

499 00:28:07.230 --> 00:28:09.700 But nowhere in the action plan

500 00:28:09.700 --> 00:28:13.970 is the issue of animal manure management,

501 00:28:13.970 --> 00:28:16.440 and its ecosystem impact.

502 00:28:16.440 --> 00:28:21.440 And that is a major oversight, and we won't make any headway

503 00:28:21.960 --> 00:28:24.383 until that is addressed.

504 00:28:25.630 --> 00:28:28.250 Now there are strategies to reduce methane

505 00:28:28.250 --> 00:28:31.190 and nitrous oxide in terms of manure management.

506 00:28:31.190 --> 00:28:33.280 You can change the way manure is stored.

507 00:28:33.280 --> 00:28:37.540 You can have methane digesters capturing it,

508 00:28:37.540 --> 00:28:40.430 converting it into renewable energy.

509 00:28:40.430 --> 00:28:42.550 For agricultural soil management

510 00:28:42.550 --> 00:28:45.950 there are strategies to use low nitrogen fertilizer,

511 00:28:45.950 --> 00:28:48.320 you can have drip irrigation.

512 00:28:48.320 --> 00:28:50.763 No till farming where you're tilling,

513 00:28:50.763 --> 00:28:54.680 when you till you release methane, nitrous oxide.

514 00:28:54.680 --> 00:28:56.490 The use of cover crops.

515 00:28:56.490 --> 00:28:58.970 So there are strategies in agriculture

516 00:28:58.970 --> 00:29:03.843 where you can reduce the nitrous oxide emissions.

517 00:29:04.990 --> 00:29:07.560 Unfortunately, there's been no mention

518 00:29:07.560 --> 00:29:10.610 of agriculture's contributions

519 00:29:10.610 --> 00:29:12.090 to greenhouse gas emissions.

520 00:29:12.090 --> 00:29:15.770 There was no mention of it in the Paris Climate Agreement.

521 00:29:15.770 --> 00:29:20.770 There was no mention of it in COP26 in Glasgow.

522 00:29:21.400 --> 00:29:23.490 There was some mention of it,

523 00:29:23.490 --> 00:29:28.490 there's recognition of it at COP23 in Fiji in 2017,

524 00:29:30.010 --> 00:29:32.030 but most of the,

525 00:29:32.030 --> 00:29:35.000 and they weren't really able to get very far,

526 00:29:35.000 --> 00:29:40.000 but most of the discussion was on climate changes impact

527 00:29:41.030 --> 00:29:43.190 or threat to agriculture,

528 00:29:43.190 --> 00:29:46.880 not so much on agriculture's contributions

529 00:29:46.880 --> 00:29:48.360 to climate change.

530 00:29:48.360 --> 00:29:51.783 So, both of them need to be discussed.

531 00:29:52.750 --> 00:29:57.750 In California, there was a bill that was passed in 2014

532 00:29:58.028 --> 00:30:00.723 to reduce methane.

533 00:30:01.830 --> 00:30:04.470 They allocated 12 million to support

534 00:30:04.470 --> 00:30:08.903 dairy methane reduction projects using dairy digesters.

535 00:30:09.930 --> 00:30:14.850 New York State recently passed the Climate Leadership

536 00:30:14.850 --> 00:30:19.320 and Community Protection Act into law in 2019.

537 00:30:19.320 --> 00:30:24.320 And there is a brief little mention of management practices

538 00:30:24.530 --> 00:30:27.660 and land use and agriculture and forestry

539 00:30:27.660 --> 00:30:30.100 for long term carbon sequestration,

540 00:30:30.100 --> 00:30:34.220 but, not so much focusing on methane

541 00:30:34.220 --> 00:30:38.023 and nitrous oxide emissions from agriculture.

542 00:30:39.000 --> 00:30:40.010 The U.S. Congress,

543 00:30:40.010 --> 00:30:43.740 there was the Agriculture Resilience Act of 2021

544 00:30:43.740 --> 00:30:46.650 that was introduced with a goal to re,

545 00:30:46.650 --> 00:30:50.660 for a 50% reduction in net greenhouse gas emissions

546 00:30:50.660 --> 00:30:53.813 in agriculture, but this bill has not been passed.

547 00:30:55.921 --> 00:30:58.850 So there are efforts.

548 00:30:58.850 --> 00:31:02.320 They need political support to get this done.

549 00:31:02.320 --> 00:31:04.783 This is a role that we can all play.

550 00:31:05.730 --> 00:31:08.820 And to sum up, we wanna restore our beautiful planet.

551 00:31:08.820 --> 00:31:12.360 One Health recognizes that life is interconnected,

552 00:31:12.360 --> 00:31:16.700 and the matrix analysis that we've done

553 00:31:16.700 --> 00:31:19.720 shows that there are microbial connections

554 00:31:19.720 --> 00:31:21.860 between food safety and security,

555 00:31:21.860 --> 00:31:25.200 antimicrobial resistance and climate change.

556 00:31:25.200 --> 00:31:27.950 We all need to work together

557 00:31:27.950 --> 00:31:29.920 to promote One Health education,

558 00:31:29.920 --> 00:31:34.620 research, policy development, and outreach for the public

559 00:31:34.620 --> 00:31:37.580 and for the policy makers to understand

560 00:31:37.580 --> 00:31:41.020 these connections and why we need to address them

561 00:31:41.020 --> 00:31:44.740 if we wanna continue agriculture

562 00:31:44.740 --> 00:31:49.170 and food security and civilization on the one hand,

563 00:31:49.170 --> 00:31:53.120 and the continuation of antimicrobials

564 00:31:53.120 --> 00:31:55.963 and modern medicine on the other.

565 00:31:57.210 --> 00:31:59.080 If you're more interested in One Health

566 00:31:59.080 --> 00:32:02.360 I have a Coursera course available

567 00:32:02.360 --> 00:32:05.950 focusing on primarily zoonotic diseases,

568 00:32:05.950 --> 00:32:08.023 also food safety and security.

569 00:32:09.280 --> 00:32:10.980 I'd like to acknowledge my colleagues

570 00:32:10.980 --> 00:32:13.050 in the One Health initiative.

571 00:32:13.050 --> 00:32:14.880 And I'd like to thank all of you

572 00:32:14.880 --> 00:32:16.900 for your time and attention,

573 00:32:16.900 --> 00:32:20.420 and am happy to take any questions.

574 00:32:20.420 --> 00:32:21.283 So thank you.

575 00:32:22.960 --> 00:32:26.997 <v ->Thank you Laura. (audience applauding)</v>

576 00:32:27.969 --> 00:32:29.680 For our online audiences,

577 00:32:29.680 --> 00:32:31.360 if you do have any questions,

578 00:32:31.360 --> 00:32:34.770 so please type your question in the chat box.

579 00:32:34.770 --> 00:32:36.910 And while you're thinking about the questions,

580 00:32:36.910 --> 00:32:39.310 we do have already pre-collected

581 00:32:39.310 --> 00:32:41.760 the questions from our students.

582 00:32:41.760 --> 00:32:44.119 I mean they're over excited by this topic,

583 00:32:44.119 --> 00:32:48.550 and, we have a couple of questions to ask.

584 00:32:48.550 --> 00:32:52.560 The first one is regarding the, manure management.

585 00:32:52.560 --> 00:32:55.533 So, the students, couple of students were wondering like,

586 00:32:55.533 --> 00:33:00.533 are there any other ways that we can reduce the animal waste

587 00:33:02.140 --> 00:33:04.506 other than, just the manure you mentioned

588 00:33:04.506 --> 00:33:06.383 the anti, you know,

589 00:33:07.640 --> 00:33:10.280 mentioned the greenhouse gas emission issue,

590 00:33:10.280 --> 00:33:14.160 that, (indistinct) infectious disease issue.

591 00:33:14.160 --> 00:33:17.593 So what are the other ways that we can do about it?

592 00:33:18.776 --> 00:33:20.250 <v ->Well that's a great question.</v>

593 00:33:20.250 --> 00:33:22.670 We need to figure out what are we going to be doing

594 00:33:22.670 --> 00:33:26.500 with this trillion of kilograms of animal of waste

595 00:33:26.500 --> 00:33:28.630 that's being produced each year.

596 00:33:28.630 --> 00:33:31.430 Again, sanitation systems

597 00:33:31.430 --> 00:33:34.633 are designed to process human waste.

598 00:33:35.540 --> 00:33:37.150 There's no system

599 00:33:37.150 --> 00:33:41.730 that I'm aware of that is designed to process animal waste.

600 00:33:41.730 --> 00:33:44.743 And if animal waste isn't being used as fertilizer,

601 00:33:44.743 --> 00:33:47.290 then it's not clear what it's being used for.

602 00:33:47.290 --> 00:33:52.140 And I think this is, an opportunity

603 00:33:52.140 --> 00:33:56.010 public private partnership to try to figure out

604 00:33:56.010 --> 00:33:58.923 what to do with all of this animal waste.

605 00:34:00.526 --> 00:34:04.660 You know, I've just, all I've seen really

606 00:34:04.660 --> 00:34:09.440 is the methane digester collecting the methane from it,

607 00:34:09.440 --> 00:34:12.910 but, it's not really been used much

608 00:34:12.910 --> 00:34:14.920 for anything other than fertilizer.

609 00:34:14.920 --> 00:34:16.623 And if it's not being used for fertilizer,

610 00:34:16.623 --> 00:34:19.070 then it's not really being used for anything

611 00:34:19.070 --> 00:34:21.570 other than contaminating the soil,

612 00:34:21.570 --> 00:34:22.910 the water and the atmosphere.

613 00:34:22.910 --> 00:34:26.960 So it's a major unaddressed problem

614 00:34:26.960 --> 00:34:31.170 that we as a civilization must figure out

615 00:34:31.170 --> 00:34:36.170 if we want to have a more sustainable future.

616 00:34:37.800 --> 00:34:38.633 <v ->Thanks Laura.</v>

617 00:34:38.633 --> 00:34:42.773 We do have another question regarding the policy.

618 00:34:44.050 --> 00:34:46.640 We can see obstacles or implications

619 00:34:46.640 --> 00:34:49.770 for this One Health framework.

620 00:34:49.770 --> 00:34:53.650 I think, we see that a comment from Dean (indistinct)

621 00:34:53.650 --> 00:34:55.990 also kind of related this issue,

622 00:34:55.990 --> 00:34:59.200 so I will read this question first.

623 00:34:59.200 --> 00:35:02.970 So we have powerful economic interest in fossil fuels.

624 00:35:02.970 --> 00:35:07.970 Food industry is, what political and economic strategies

625 00:35:08.090 --> 00:35:11.000 have been successful to pivot the western interest

626 00:35:11.000 --> 00:35:13.910 to consider the alliances.

627 00:35:13.910 --> 00:35:14.743 So,

628 00:35:15.790 --> 00:35:17.570 for example, progressing such elements

629 00:35:17.570 --> 00:35:20.210 as the use of manure as fertilizer,

630 00:35:20.210 --> 00:35:23.140 use of low water agriculture practices.

631 00:35:23.140 --> 00:35:24.530 Animal feeding,

632 00:35:24.530 --> 00:35:28.210 feeding including 10% seaweed to reduce methane.

633 00:35:28.210 --> 00:35:30.557 There are industry and now there are products,

634 00:35:30.557 --> 00:35:33.193 electric, electric copper (indistinct) et cetera.

635 00:35:34.980 --> 00:35:37.980 <v ->Well, you know I'm very interested</v>

636 00:35:37.980 --> 00:35:41.790 that California and New York state

637 00:35:41.790 --> 00:35:45.920 were able to pass some legislation.

638 00:35:45.920 --> 00:35:49.390 I'm not aware of other states doing this.

639 00:35:49.390 --> 00:35:52.900 So, I'm very interested to find out

640 00:35:52.900 --> 00:35:55.760 what were the political conditions

641 00:35:55.760 --> 00:35:58.690 that allowed these states to do this.

642 00:35:58.690 --> 00:36:03.470 And I'm not aware of countries doing this, you know,

643 00:36:03.470 --> 00:36:06.970 focusing on these is these areas.

644 00:36:06.970 --> 00:36:11.163 So, I think it's a right for study,

645 00:36:12.060 --> 00:36:16.790 to figure out how we can tip the politics

646 00:36:16.790 --> 00:36:21.790 to get legislation in place or to get companies in place

647 00:36:23.760 --> 00:36:26.480 that are, you know, that their mission

648 00:36:26.480 --> 00:36:31.480 is to address manure's impact on the environment

649 00:36:33.300 --> 00:36:35.133 or on ecosystems.

650 00:36:36.100 --> 00:36:39.880 There is some research done at UC Davis

651 00:36:39.880 --> 00:36:44.880 on using seaweed to reduce Enteric fermentation.

652 00:36:46.650 --> 00:36:50.860 Now seaweed has a compound in it called bromoform.

653 00:36:50.860 --> 00:36:53.320 And apparently bromoform

654 00:36:53.320 --> 00:36:56.220 if it's released into the atmosphere

655 00:36:56.220 --> 00:36:59.933 it has deleterious effects on ozone.

656 00:37:01.990 --> 00:37:06.600 So, we don't want to solve one problem by worsening another.

657 00:37:06.600 --> 00:37:10.000 So we have to be very careful in whatever we do

658 00:37:10.000 --> 00:37:14.820 to make sure that our solutions

659 00:37:14.820 --> 00:37:17.800 don't cause unintended consequences.

660 00:37:17.800 --> 00:37:21.383 But, you know I think this is all still in its infancy.

661 00:37:23.240 --> 00:37:24.124 <v ->Thanks Laura, yeah.</v>

662 00:37:24.124 --> 00:37:27.213 I think a related question from students is that,

663 00:37:27.213 --> 00:37:31.604 this is a fascinating idea, the framework of One Health,

664 00:37:31.604 --> 00:37:34.480 and you actually mentioned a lot of those things

665 00:37:34.480 --> 00:37:38.410 in actually considering the policy engagement.

666 00:37:38.410 --> 00:37:42.190 So overall, the students are interested to know that,

667 00:37:42.190 --> 00:37:45.010 what do you think are the largest obstacle you see

668 00:37:45.010 --> 00:37:49.450 to kind of engage, or implement the One Health framework

669 00:37:49.450 --> 00:37:50.750 into the current policies?

670 00:37:51.930 --> 00:37:53.673 <v ->I think, well,</v>

671 00:37:54.570 --> 00:37:58.710 this concept has been largely driven by veterinarians.

672 00:37:58.710 --> 00:38:01.360 It's been very hard to get the medical,

673 00:38:01.360 --> 00:38:04.060 the human community engaged.

674 00:38:04.060 --> 00:38:06.510 They don't necessarily see the connections

675 00:38:06.510 --> 00:38:07.993 or the bigger picture.

676 00:38:09.150 --> 00:38:12.390 In terms of the medical profession it's under siege,

677 00:38:12.390 --> 00:38:14.250 at least in this country.

678 00:38:14.250 --> 00:38:17.110 There has been more interest in One Health in Europe,

679 00:38:17.110 --> 00:38:20.900 in, on the continent of Africa, Asia,

680 00:38:20.900 --> 00:38:24.570 less so in the United States again, not sure why.

681 00:38:24.570 --> 00:38:28.463 I think our divided politics is certainly not helping.

682 00:38:29.470 --> 00:38:33.220 So, my goal is to try and get the word out,

683 00:38:33.220 --> 00:38:37.720 my colleagues as well, through our advocacy work,

684 00:38:37.720 --> 00:38:40.410 through promoting the concept.

685 00:38:40.410 --> 00:38:43.210 And, I'm very grateful to you

686 00:38:43.210 --> 00:38:46.233 to give me an opportunity to speak to your students today.

687 00:38:47.680 --> 00:38:49.985 <v ->Thanks Laura, we're thrilled to have you here</v>

688 00:38:49.985 --> 00:38:52.420 and I'm sure this is a very exciting topic

689 00:38:52.420 --> 00:38:54.417 that we have a very large online audience

690 00:38:54.417 --> 00:38:56.410 and that's the one of the evidence or proof.

691 00:38:56.410 --> 00:39:00.120 So, another thing that the students

692 00:39:00.120 --> 00:39:04.217 are quite interested in is that, you know,

693 00:39:05.627 --> 00:39:10.627 you have a fascinating career as a researcher, as educator.

694 00:39:11.120 --> 00:39:16.120 So, our audience today, the students and PhD students,

695 00:39:16.700 --> 00:39:18.340 so they are wondering,

696 00:39:18.340 --> 00:39:20.390 can you talk a little more

697 00:39:20.390 --> 00:39:23.020 about your personal experience?

698 00:39:23.020 --> 00:39:26.730 About your route in the field as a woman in the STEM field.

699 00:39:26.730 --> 00:39:29.540 So it's kinda very general just for the students.

700 00:39:29.540 --> 00:39:30.373 Yeah.

701 00:39:31.860 --> 00:39:34.180 <v ->Well, you know, I wish I could say</v>

702 00:39:34.180 --> 00:39:38.538 that I had a laser focus on this,

703 00:39:38.538 --> 00:39:42.880 but, I started out in nursing.

704 00:39:42.880 --> 00:39:45.780 My interest was always in public health,

705 00:39:45.780 --> 00:39:49.070 and, I worked as a nurse for a couple of years

706 00:39:49.070 --> 00:39:51.680 before deciding to go premed

707 00:39:51.680 --> 00:39:54.480 and then went back to do a Postbaccalaureate.

708 00:39:54.480 --> 00:39:58.790 This was long before they had Postbaccalaureate programs.

709 00:39:58.790 --> 00:40:01.020 But I did that and got into medical school.

710 00:40:01.020 --> 00:40:04.690 My interest was always in, again, public health,

711 00:40:04.690 --> 00:40:05.903 the big picture.

712 00:40:07.170 --> 00:40:12.030 I did a, internal medicine residency

713 00:40:12.030 --> 00:40:14.350 and then got a master's in public health

714 00:40:14.350 --> 00:40:17.313 and a general medicine fellowship at Columbia.

715 00:40:18.190 --> 00:40:22.453 And was working in government doing,

716 00:40:24.080 --> 00:40:28.000 first, I was doing drug safety oversight at the FDA,

717 00:40:28.000 --> 00:40:31.320 and then moved to the New Jersey Department of Health,

718 00:40:31.320 --> 00:40:34.940 where I was doing hospital quality oversight,

719 00:40:34.940 --> 00:40:38.180 when I decided to get a master's in public policy,

720 00:40:38.180 --> 00:40:41.220 and there were a variety of reasons for that.

721 00:40:41.220 --> 00:40:45.050 And just as I was about to start my master in public policy,

722 00:40:45.050 --> 00:40:48.505 this was in the fall of 2001.

723 00:40:48.505 --> 00:40:53.000 And, if you remember what happened in the fall of 2001,

724 00:40:53.000 --> 00:40:55.930 it was, turned our world upside down

725 00:40:55.930 --> 00:40:58.920 the terrorist attacks of 9/11,

726 00:40:58.920 --> 00:41:02.590 followed a month later by the anthrax crisis,

727 00:41:02.590 --> 00:41:06.020 and that changed the trajectory of my career.

728 00:41:06.020 --> 00:41:08.843 I went into bio defense.

729 00:41:09.756 --> 00:41:12.320 And, I took a course,

730 00:41:12.320 --> 00:41:14.960 prevention against weapons of mass destruction,

731 00:41:14.960 --> 00:41:18.450 where the focus was on nuclear issues, nuclear discernment,

732 00:41:18.450 --> 00:41:22.033 but I was interested in the biological aspects of it.

733 00:41:22.950 --> 00:41:25.500 I joined that research group,

734 00:41:25.500 --> 00:41:29.420 and, in the course of my policy research,

735 00:41:29.420 --> 00:41:31.970 reading the veterinary medical literature,

736 00:41:31.970 --> 00:41:35.140 it was stunning to me that there was this overlap

737 00:41:35.140 --> 00:41:39.320 between the agents of bioterrorism on the one hand,

738 00:41:39.320 --> 00:41:42.760 and emerging infectious diseases on the other,

739 00:41:42.760 --> 00:41:46.280 in that the vast majority of both were zoonotic,

740 00:41:46.280 --> 00:41:48.140 meaning that they were diseases of animals

741 00:41:48.140 --> 00:41:50.150 that infect people.

742 00:41:50.150 --> 00:41:53.550 And yet, I discovered that physicians

743 00:41:53.550 --> 00:41:56.890 and veterinarians rarely ever talked to each other.

744 00:41:56.890 --> 00:41:59.450 And in fact, in my entire medical training

745 00:41:59.450 --> 00:42:02.280 I never once heard the term zoonosis,

746 00:42:02.280 --> 00:42:05.513 that's a veterinary term, it's not a medical term.

747 00:42:06.410 --> 00:42:08.520 So, it was this huge issue

748 00:42:08.520 --> 00:42:11.230 that was just not getting addressed.

749 00:42:11.230 --> 00:42:14.720 And, that's what prompted me to do my research

750 00:42:14.720 --> 00:42:16.470 and to write up that article

751 00:42:16.470 --> 00:42:20.970 in the emerging infectious disease journal in 2006.

752 00:42:20.970 --> 00:42:23.970 And I got a huge response from the veterinarians,

753 00:42:23.970 --> 00:42:27.470 and I heard not, I heard crickets from the physicians,

754 00:42:27.470 --> 00:42:32.470 and that lack of interest has continued.

755 00:42:32.550 --> 00:42:37.064 Not clear if COVID 19 will change things,

756 00:42:37.064 --> 00:42:39.463 but I'm not so sure.

757 00:42:41.290 --> 00:42:42.123 <v ->Thanks Laura.</v>

758 00:42:42.123 --> 00:42:44.480 I think this is a fascinating story,

759 00:42:44.480 --> 00:42:48.533 I'm sure people, students will be inspired by your story.

760 00:42:48.533 --> 00:42:50.433 And, since you mentioned the COVID 19,

761 00:42:51.662 --> 00:42:54.463 one of the questions students have exactly,

762 00:42:55.580 --> 00:42:59.240 how has the One Health community responded to the COVID 19?

763 00:42:59.240 --> 00:43:03.557 especially, regarding the start of this pandemic

764 00:43:03.557 --> 00:43:07.850 has a lot to do with animals in China, treating everything.

765 00:43:07.850 --> 00:43:09.883 So what do you comment on that?

766 00:43:11.740 --> 00:43:12.930 <v ->Yeah.</v>

767 00:43:12.930 --> 00:43:15.440 Well, those of us in biodefense,

768 00:43:15.440 --> 00:43:19.070 I mean, this was a catastrophe waiting to happen

769 00:43:19.070 --> 00:43:20.650 for a variety of reasons.

770 00:43:20.650 --> 00:43:21.800 I mean, one of the,

771 00:43:21.800 --> 00:43:24.640 I mean, it was very clear and I'm,

772 00:43:24.640 --> 00:43:27.040 right now I'm researching and writing a book

773 00:43:27.040 --> 00:43:31.920 about One Health and the COVID 19 pandemic.

774 00:43:31.920 --> 00:43:33.650 So I'm using this framework

775 00:43:33.650 --> 00:43:37.610 to examine this pandemic from all angles.

776 00:43:37.610 --> 00:43:41.480 And, there's several things that have come out

777 00:43:41.480 --> 00:43:44.430 in my investigation.

778 00:43:44.430 --> 00:43:48.400 If you compare this pandemic with SARS

779 00:43:48.400 --> 00:43:53.400 that emerged in 2002-2003 in the Guandong province of China,

780 00:43:55.670 --> 00:44:00.190 and with MERS, Middle East respiratory syndrome

781 00:44:00.190 --> 00:44:03.260 that emerged from Saudi Arabia in 2012.

782 00:44:05.995 --> 00:44:06.833 In both those spillover events

783 00:44:11.470 --> 00:44:16.260 there was very clear evidence of a natural spillover event.

784 00:44:16.260 --> 00:44:21.260 In the case of SARS, there was, almost an exact match

785 00:44:22.267 --> 00:44:27.267 of the virus in animals with the human strain.

786 00:44:29.250 --> 00:44:31.210 And also importantly,

787 00:44:31.210 --> 00:44:33.940 there was occupational evidence

788 00:44:33.940 --> 00:44:36.910 that the people who were working with the animals

789 00:44:36.910 --> 00:44:41.180 had a higher rate of antibodies,

790 00:44:41.180 --> 00:44:44.940 higher sero prevalence rate of antibodies

791 00:44:44.940 --> 00:44:48.900 to the virus compared to the general population.

792 00:44:48.900 --> 00:44:50.650 You saw that with SARS.

793 00:44:50.650 --> 00:44:55.120 Similarly with MERS, there was clear,

794 00:44:55.120 --> 00:44:58.330 the virus was identified,

795 00:44:58.330 --> 00:45:01.890 isolated from Dromedary camels.

796 00:45:01.890 --> 00:45:06.120 And they looked back there was serologic evidence

797 00:45:06.120 --> 00:45:09.650 from the camels going back decades,

798 00:45:09.650 --> 00:45:11.850 showing that the virus had been is circulating

799 00:45:11.850 --> 00:45:13.860 in these animals long before

800 00:45:13.860 --> 00:45:16.213 there was a spillover event into a human.

801 00:45:17.494 --> 00:45:22.330 And again, they did a serologic survey of large,

802 00:45:22.330 --> 00:45:25.510 like 10,000 people in Saudi Arabia.

803 00:45:25.510 --> 00:45:29.600 And again, there was occupational evidence,

804 00:45:29.600 --> 00:45:33.080 exposure of those who were working in the slaughter house

805 00:45:33.080 --> 00:45:35.180 or those who were working with the camels

806 00:45:35.180 --> 00:45:39.880 had a much higher sero prevalence rate of antibodies

807 00:45:40.980 --> 00:45:44.090 to MERS than to the general population.

808 00:45:44.090 --> 00:45:48.500 Now, none of those things are evident with COVID 19.

809 00:45:48.500 --> 00:45:51.263 There has been zero animal,

810 00:45:52.570 --> 00:45:55.420 there's been no animal host,

811 00:45:55.420 --> 00:46:00.420 intermediate host of this virus, unlike SARS and MERS.

812 00:46:00.470 --> 00:46:04.740 And there's no serologic evidence of occupational exposure

813 00:46:04.740 --> 00:46:09.740 in the animal work, in the workers in the Wuhan market.

814 00:46:12.558 --> 00:46:15.520 That paints a similar picture

815 00:46:15.520 --> 00:46:17.963 to what we saw with SARS and MERS.

816 00:46:18.920 --> 00:46:23.920 So, that leads us to a conundrum as to how this started,

817 00:46:25.130 --> 00:46:28.160 because we need to figure out how this started

818 00:46:28.160 --> 00:46:32.300 so we can prevent another one from happening.

819 00:46:32.300 --> 00:46:36.780 And, I know this is a very political issue

820 00:46:36.780 --> 00:46:39.550 in terms of the origin of the virus,

821 00:46:39.550 --> 00:46:42.240 but right now there is no evidence

822 00:46:42.240 --> 00:46:44.140 that it was a natural spillover event.

823 00:46:45.890 --> 00:46:46.723 <v ->Thanks Laura.</v>

824 00:46:48.127 --> 00:46:51.440 I do want to give the opportunity to, for an audience,

825 00:46:51.440 --> 00:46:54.220 if you have any other questions

826 00:46:54.220 --> 00:46:56.033 so feel free to speak up.

827 00:46:59.130 --> 00:47:00.820 And also for online audience,

828 00:47:00.820 --> 00:47:03.340 if you have any other questions,

829 00:47:03.340 --> 00:47:05.443 please type in the chat box.

830 00:47:08.980 --> 00:47:09.970 Yeah.

831 00:47:09.970 --> 00:47:10.867 Professor (indistinct).

832 00:47:11.856 --> 00:47:14.313 <v ->Yeah hi, thanks for that great talk.</v>

833 00:47:15.330 --> 00:47:17.370 I just wanted to raise a point

834 00:47:17.370 --> 00:47:20.340 that re-enforces the complexity of these issues,

835 00:47:20.340 --> 00:47:25.080 which is the capture of methane from manure,

836 00:47:25.080 --> 00:47:28.390 and using it as so-called renewable natural gas,

837 00:47:28.390 --> 00:47:31.320 which is what some people are calling it.

838 00:47:31.320 --> 00:47:35.230 And so, a lot of environmental justice people,

839 00:47:35.230 --> 00:47:40.160 are actually against the use of that in CAFOs.

840 00:47:40.160 --> 00:47:44.930 Cause they feel that it essentially entrenches the CAFOs

841 00:47:44.930 --> 00:47:48.450 when, CAFOs as you pointed out

842 00:47:48.450 --> 00:47:50.180 have a lot of problems

843 00:47:50.180 --> 00:47:52.500 for the surrounding communities, et cetera,

844 00:47:52.500 --> 00:47:55.770 where a lot of people feel they need to be fundamentally

845 00:47:55.770 --> 00:48:00.160 reformed as a, and that the renewable natural gas

846 00:48:00.160 --> 00:48:01.653 is a form of greenwashing.

847 00:48:02.550 --> 00:48:04.179 So I don't know if you've heard that argument,

848 00:48:04.179 --> 00:48:06.160 but I just wanted to put that out there

849 00:48:06.160 --> 00:48:08.220 and see how you respond.

850 00:48:08.220 --> 00:48:10.060 <v ->Yeah, thank you for that comment.</v>

851 00:48:10.060 --> 00:48:13.010 Well, yes, I know a lot of people

852 00:48:13.010 --> 00:48:14.480 in the environmental community

853 00:48:14.480 --> 00:48:16.447 are against doing anything with the CAFOs

854 00:48:16.447 --> 00:48:19.347 'cause they feel they should all be going out of business.

855 00:48:20.490 --> 00:48:23.810 I think given that eating meat is the norm

856 00:48:23.810 --> 00:48:26.570 in most countries,

857 00:48:26.570 --> 00:48:30.130 I think expecting people to become vegetarian

858 00:48:30.130 --> 00:48:32.223 or vegan is unrealistic.

859 00:48:33.250 --> 00:48:35.170 I did not include my slide

860 00:48:35.170 --> 00:48:37.900 on the pros and cons to eating meat.

861 00:48:37.900 --> 00:48:41.540 There are pros of course, and there are cons.

862 00:48:41.540 --> 00:48:45.270 And some have argued that we evolved into modern humans

863 00:48:45.270 --> 00:48:47.383 because we hunted cooked and ate meat.

864 00:48:49.068 --> 00:48:50.730 You know, again, that's debatable,

865 00:48:50.730 --> 00:48:55.730 but, nevertheless, that it is deeply ingrained

866 00:48:56.340 --> 00:48:59.410 in our cultures and our religions,

867 00:48:59.410 --> 00:49:03.290 and I think we need to be realistic

868 00:49:03.290 --> 00:49:05.100 in what we're dealing with.

869 00:49:05.100 --> 00:49:07.730 So, we need to try and make civilization

870 00:49:07.730 --> 00:49:09.663 as sustainable as possible,

871 00:49:10.902 --> 00:49:15.902 and figure out ways to curtail the negative externalities

872 00:49:16.030 --> 00:49:17.683 of these industries,

873 00:49:18.930 --> 00:49:22.060 recognizing that, it would be ideal

874 00:49:22.060 --> 00:49:23.660 if everyone became vegetarian,

875 00:49:23.660 --> 00:49:25.480 but again, I think that's,

876 00:49:25.480 --> 00:49:29.310 I mean, we're divided politically as it is,

877 00:49:29.310 --> 00:49:31.890 demanding that people change

878 00:49:31.890 --> 00:49:36.550 their deeply ingrained eating behavior, not easy to do.

879 00:49:36.550 --> 00:49:41.030 I mean, it's hard to do, as a practicing physician,

880 00:49:41.030 --> 00:49:44.300 to tell somebody to cut back on meat,

881 00:49:44.300 --> 00:49:47.640 telling an entire culture or an entire society,

882 00:49:47.640 --> 00:49:50.693 it's just not realistic in my book.

883 00:49:54.370 --> 00:49:55.203 <v ->Thanks Laura.</v>

884 00:49:55.203 --> 00:49:57.650 I think, are kind of related to question

885 00:49:57.650 --> 00:50:00.660 to your last point, is the students also recognize that

886 00:50:00.660 --> 00:50:04.820 it's (indistinct) to just shut down the meat consumption.

887 00:50:04.820 --> 00:50:08.150 So the students, they have an interesting question for you

888 00:50:08.150 --> 00:50:10.970 is that, do you think like to what extent

889 00:50:10.970 --> 00:50:14.060 do the more, so called, the affluent countries

890 00:50:14.060 --> 00:50:15.930 that have lot of power resources

891 00:50:15.930 --> 00:50:20.930 need to subsidize better sanitation systems in places

892 00:50:21.962 --> 00:50:24.280 for, with low middle income countries

893 00:50:24.280 --> 00:50:27.413 that they are lacking the resources.

894 00:50:28.300 --> 00:50:29.254 So do you think this, yeah.

895 00:50:29.254 --> 00:50:30.300 <v ->Well.</v>

896 00:50:30.300 --> 00:50:35.060 Yeah, I mean, we have a responsibility.

897 00:50:35.060 --> 00:50:37.930 I mean, since we've been such major energy users

898 00:50:37.930 --> 00:50:40.710 and meat consumers in this country,

899 00:50:40.710 --> 00:50:43.840 I think we have an obligation to other countries

900 00:50:43.840 --> 00:50:47.403 to try to ensure their survival.

901 00:50:48.510 --> 00:50:50.710 There's much more that we can be doing,

902 00:50:50.710 --> 00:50:55.710 and I think those are important topics for, worthy of study

903 00:50:55.800 --> 00:50:59.060 and you know, and other courses.

904 00:50:59.060 --> 00:51:04.060 So, again, there's much that can be done that we must do.

905 00:51:06.470 --> 00:51:07.780 <v ->Thanks Laura.</v>

906 00:51:07.780 --> 00:51:09.873 Any other follow on questions?

907 00:51:14.130 --> 00:51:15.187 So thank you,

908 00:51:15.187 --> 00:51:17.230 thank you Dr. Kahn for a wonderful talk,

909 00:51:17.230 --> 00:51:19.790 and thanks for everyone for joining us online

910 00:51:19.790 --> 00:51:21.446 and also in person.

911 00:51:21.446 --> 00:51:23.010 <v ->Well, thank you so much for having me,</v>

912 00:51:23.010 --> 00:51:25.260 it was a pleasure to be with all of you.

913 00:51:25.260 --> 00:51:26.093 <v ->Thank you so much.</v>

914 00:51:26.093 --> 00:51:26.926 Just a reminder,

915 00:51:26.926 --> 00:51:30.010 our recording will be online on central website,

916 00:51:30.010 --> 00:51:31.763 so thanks again Dr. Kahn.

917 00:51:31.763 --> 00:51:33.153 (audience applauding)