DESIGING ARABLE ROTATIONS AND RELATED MACHINERY AND STAFFING REQUIREMENTS ON A CASE STUDY FARM

Farm Report 2020/2021

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Report Description

This report reviews NUFarms' arable crop rotations, presents plans for future rotations, provides gross margins budgets and uses standard charges for cultivation activities to present a "net" margins for each crop. Based on this rotation, the report presents a machinery replacement policy for selected items of equipment (provided by the farmer) and staffing requirements. NUFarms is a mixed farming operation, but this assessment refers only to the arable enterprises in the rotations.

Executive Summary

The key findings and recommendations are:

- Grow first winter wheat (WW1) crops every other year. This will improve profit margins and also allow the arable land at (the distant) Cockle Park to be farmed as a single block.
- Change to the proposed blocking patterns across NUFarms that is, creates two large blocks which alternate in growing WW1 – this will simplify the rotation, and reduce the need to move equipment the 22 or so miles between Cockle Park and Nafferton/Cheeseburn.
- I recommend including the Countryside Stewardship environmental option Enhanced Overwinter Stubble (EOS) (AB6) in the rotation (see RPA 2021). This provides a payment of £436/ha payment and involves little by way of compliance costs (variable or direct costs) which makes it a profitable and financially safe option, especially relevant to the heavier land and to the reclaimed open cast farmland. It also helps to spread revenue risk and reduces Autumn workloads, and can provide a good entry for the spring cropping.
- The withdrawal of BPS will quickly have an adverse impact on farm revenue with an estimated reduction in income of £72,881 by 2027 (intermediate annual reductions are shown below).
- Therefore, I would advise the farm is proactive in enrolling on to the Environmental Land Management Scheme (ELMS) as soon as it is rolled out (planned date is 2024 (Gov.uk, 2020)).
- I advise you continue to farm the farm in-hand rather than use contractors.
- With respect to machinery use, I recommend continuing to move towards minimum tillage, which means the Kuhn Combi will eventually become redundant. However, I

recommend retaining this item of equipment as a "safety net" for use in wet years – which have been common in this part of the UK in recent years.

Recommending crop rotation and blocking system

The advised rotation is set out in Table 1. The advised land blocks are set out in Table 2. The blocks divide the farmland into six roughly equal blocks, spread over the three farm sites (Cockle Park, Nafferton and Cheeseburn). The is designed to reduce the need to move equipment and staff the 22 miles between Cockle Park and Nafferton/Cheeseburn.

Rotation

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6		
Сгор	WW1	OSR	WW1	EOS	WW1	WBns		
(WW1 = first crop winter wheat, OSR is Oil Seed Rape, EOS is Environmental								
Management Option AB6), WBns is winter beans).								

Table 1 – Recommended crop rotation.

Blocks one, two and three are located at Cockle Park. This allows the land to always be sown with winter wheat in the same year, which will simply the logistic of crop preparation, sowing, management and harvesting. This will reduce staff time and save on fuel use, thus helping to reduce the farm's carbon footprint.

The principal advantage of this rotation is it allows winter wheat (WW1), the highest earning crop, to be grown every other year.

Year 4 of the rotation includes Countryside Stewardship (CS) Enhanced Overwinter Stubble (AB6). This is a CS mid-tier environmental management option which involves leaving the ground untouched over the winter. This is designed to encourage naturally occurring arable crops to grow and provide forage for farmland birds and pollinating insects. A payment of £436/ha/year and is attached, and is therefore a source of stable income (Gov.uk (2019)). By 2023, 75.5ha will be entered into the mid-tier stewardship scheme through this Enhanced Overwinter Stubble (EOS) option. This will alleviate demands on labour and equipment, making it even more attractive.

Table 2 - Fields in each block

Block 1 (79.94ha)	Block 2 (75.45ha)	Block 3 (82.75ha)	Block 4 (106.55ha)	Block 5 (97.19ha)	Block 6 (106.89ha)
Saturdays	Butterwell 2	Glents	Ouston Badger	Dodley Pond 1	Back Field
School Field	Butterwell 3	Hanging Leaves	Coldside Drive	Dodley Pond 2	Back Field
School Field	David Routledge	Long Riggs	Coldside Middle	Dodley Pond 3	Fell
School Field	East Tower Hill	North Field	Oulston Cricketer	Doudley Organic 1	Old Nafferton
Stobswood F16	Lower Brick Fld	Paradise	Coldside CS 1	Doudley Organic 2	Pawson
Stobswood F17	Mid Tower Hill	West Field	Coldside CS 2	Nesbitt Road South	Quarry
Stobswood F29	Palace Leas Fld		Coldside CS 3	Nesbitt Pillar Box	Quarry
StobswoodF34	Tree Fld		Cold Georges	Nesbitt NR 1	Stelling
Brierly	Upper Brick Fld		Ouston Hole	Nesbitt NR 2	Tank Field
	West Tower Hill		Cold Horsewalk	Nesbitt LS	Welton
			Ouston Huts	East Hemmel	West
			Kiln House West	East Hemmel	
			Longfield Cold	Sixtry Acre	
			Oulston Margin	Sommerville	
			Oulston Drain		
			Cold Moorhouse		
			Ouston Old Pump		
			Oulston Slugs		
			Cold Sparrow		
			Oulston Moor Drain		

Winter beans is the least profitable crop in the rotation (Table 3 and Figure 1 below). It provides a gross margin of \pm 397, but it is an ideal break crop for the farm, being drilled later than winter cereals and fixing nitrogen. This, together with OSR and EOS as the other break crops, to grow first wheat every second year, which should then increase the overall income of the cropping.

The decision for recommending this rotation is heavily based on budgeted average gross margins of the crops – which clearly shows the financial benefits of excluding barley from the rotation (WW1 has a ± 203 higher gross margin and involves very similar fixed costs). Moreover, barley (as a cereal) is a poor break crop to a WW based rotation.

Crop	Output	Variable Costs	Gross Margin
WW1	1,513	562	950
WW2	1,395	589	806
S. Barley	1,004	388	615
W. Barley	1,189	447	743
OSR	1,050	391	659
W. Beans	703	306	397
S. Beans	627	300	327
EOS	436	0	436

Table 1 - Gross Margins for each crop (£/ha)

I would not recommend growing winter barley, but if you did want to grow this crop then I recommend substituting it for WW1 in year 3 of the rotation. This will provide between 80-100ha of WB a year <u>but will reduce my calculated gross margins as a consequence</u>.

Gross margins

Table 4 shows the area grown of each crop grown for the 2021 year and the estimated gross margin of each crop. Table 6 shows the area of each crop grown for the next eight years.

Table 2 - Area grown and total gross margin by crop (estimated for 2021)

Сгор	Area Grown (ha)	GM (£)		
WW1	164.3	156,092		
WW2	148.2 119,403			
WB	74.7	55,441		
OSR	43.7	28,785		
WBns	72.1	28,627		
EOS	34.0	14,815		
Total	536.8	403,163		

<u>Crop Areas</u> ha	2020	2021	2022	2023	2024	2025	2026	2027	Av.
WW1	129.6	164.3	127.7	310.6	238.1	310.6	238.1	310.6	228.7
WW2	40.4	148.2	110.4	0.0	0.0	0.0	0.0	0.0	37.4
WB	35.5	74.7	0.0	0.0	0.0	0.0	0.0	0.0	13.8
OSR	35.8	43.7	111.2	79.9	106.9	82.8	92.5	75.5	78.5
SBns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SB	167.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.9
WBns	0.0	72.1	106.9	82.8	92.5	75.5	111.2	79.9	77.6
EOS	0.0	34.0	92.5	75.5	111.2	79.9	106.9	82.8	72.8
Total	408.3	536.8	548.8	548.8	548.8	548.8	548.8	548.8	529.7

Table 3 - Planned area of Ha for each crop (2020-2027)

Table 6 shows how the annual change in hectarage and the effect this will have on the average gross margins/ha.

Gross Margins excl. BPS (£)	2020	2021	2022	2023	2024	2025	2026	2027	Average
	123 153	156 002	121 386	205 201	226 312	205 201	226 312	205 201	217 257
	22 577	110,032	22,300	235,201	220,312	235,201	220,312	233,201	20 121
	52,577	119,403	00,900	0	0	0	0	0	50,121
WB	26,376	55,441	0	0	0	0	0	0	10,227
OSR	23,559	28,785	73,294	52,680	70,441	54,532	60,971	49,722	51,748
SBns	0	0	0	0	0	0	0	0	0
SB	102 730	0	0	0	0	0	0	0	12,841
WBns	0	28.627	42.470	32.878	36.760	29.978	44.190	31.762	30,833
EOS	0	14.815	40.339	32.896	48.492	34.854	46.604	36.079	31,760
Total Farm Gross Margin	308,396	403,163	366,474	413,656	382,004	414,565	378,076	412,763	384,887

Table 4 - Showing estimated gross margins (2020-2027)

Crop establishment operations

I recommend the full implementation of minimal tillage across the farm. The cultivation strategies for each crop shown in Table 7 (stubble cultivate, press and drill – using the JD 750a) – will create a low disturbance seedbed for cereals.

This strategy will also increase timeliness of operations and reduce fuel costs. However, it is recommended to plough before sowing winter and spring beans. This will help control many weeds, as many weed species will not survive being buried for 6 years.

	WW1	WW2	WB	OSR	SB	EOS	SBns	WBns
Establishment								
Ploughing					1		1	1
Subsoil								
Stubble Cultivate	1	1	1					
Power Harrow								
Press	1	1	1		1		1	1
Drill	1	1	1		1		1	1
Rape Drill				1				
Roll	1	1	1	1	1		1	1
Fertiliser/Spray Application								
Fertiliser	4	3	3	4	2		1	1
Spraying	6	6	5	7	4	1	4	5
Slug Pelleting	1			1				1

 Table 5 - Crop Establishment and number of passes
 Image: Comparison of passes

The Enhanced Overwintered Stubble "EOS" crop involves little or no additional work. There is the need to spray it off before the next crop is sown, but the stale seed bed that is created is an excellent way to help manage weeds.

Operations Summary (£/ha)	Winter wheat 1 (feed)	Winter wheat 2 (feed)	Winter Barley (feed)	Winter OSR	Winter beans	Spring barley (malting)	Overwinter Stubble	Spring beans
Establishment	117	117	117	60	118	118	0	118
Fertiliser & spray application	74	65	57	82	47	43	8	37
Harvesting	72	72	72	72	72	72	0	72
Baling straw (if applicable)	44	44	44	0	0	0	0	0
Grain Carting/Haulage	142	133	120	48	61	92	0	53
Drying and storage	101	94	85	35	44	66	0	38
Total operational costs (£/ha)	551	525	495	297	342	391	8	318

Table 6 – Summary of crop Establishment costs for each crop (£per ha)

Comparison of estimated GM using contractor and average farmer costs

Figure 1 - Gross Margins per crop (Farmer vs. Contractor costs) (Data taken from Nix (2020)



Figure 1 estimated crop gross margins if operations are performed by (i) a contractor and (ii) in-house using the farm's own equipment.

The Figure shows the clear economic benefits of keeping these operations in-house, especially as you already possess the required equipment. Using a contractor for both winter or spring beans makes the crop totally unviable.

Net Margins

Net Margins excl BPS (£)	2020	2021	2022	2023	2024	2025	2026	2027	Average
WW1	51,797	65,650	51,053	124,158	95,184	124,158	95,184	124,158	91,418
WW2	11,360	41,637	31,030	0	0	0	0	0	10,503
WB	8,785	18,465	0	0	0	0	0	0	3,406
OSR	12,955	15,829	40,304	28,968	38,735	29,987	33,527	27,341	28,456
SBns	0	0	0	0	0	0	0	0	0
SB	37,359	0	0	0	0	0	0	0	4,670
WBns	0	3,961	5,876	4,549	5,086	4,148	6,115	4,395	4,266
EOS	0	14,559	39,642	32,328	47,654	34,252	45,799	35,456	31,211
Total	122,255	160,102	167,906	190,004	186,659	192,544	180,625	191,350	173,931

Table 7 - Estimated Net Margins (excl. BPS) from 2020 to 2027 (£/crop)

Table 7 shows the estimated net margins (excluding the BPS payment) for each cropping year, and the net margin for each crop. The net income should increase from 2020 to 2023 as the move to the new rotation is complete.

The main reason for the margins fluctuating from $\pounds 192,544$ in 2025 to $\pounds 180,625$ in 2026 is due to the smaller area of WW1 in the later year with a higher area of the lowest earning crop, winter beans. However, the increased income across the rotation should offset the increased year-to-year fluctuation in farm revenue.

Basic Payment Scheme (BPS)

Table 10 shows the estimated net margins for each of the next 8 years, and includes the expected BPS payments, assuming the expected diminishing payment (taken from Figure 2).

BPS Net Margins	2020	2021	2022	2023	2024	2025	2026	2027	Average
Arable Unit: Net									
Margin per ha (£)	223	292	306	346	340	351	329	349	317
Basic Payment									
Scheme* (£/ha)	230	218.5	184	149.5	115	86.25	57.25	28.75	134
Net Margin per									
ha incl. BPS									
(£/ha)	453	510	490	496	455	437	386	377	451
Total farm net									
margin incl. BPS									
(£)	248,473	280,008	268,879	272,045	249,768	239,876	212,042	207,127	247,277

Table 8 - Estimated Net Margins incl. BPS (2020-2027) (Based on AHDB online calculator)

BPS Withdrawal

Figure 2 shows the expected reduction in BPS payments until 2028 when they will be completely removed.

Figure 2 - BPS reductions (based on the online calculator produced by AHDB (2020))



Estimated reduction in BPS 2020-2028

Figure 3 shows the estimated effect this will have on the farm business net margins. The reduction of \pounds 72,881 from 2021 to 2027 is solely due to the reduction in BPS payment.

I recommend that as soon as ELMs is available, it is incorporated into the business – selecting what best suits your farming system. This will, hopefully, go some way to replacing the income lost from the withdrawal of BPS. The inclusion of EOS as a cropping

option indicates the potential financial benefits that ELMS may be able to offer, but at the time of writing this assessment, details of how much "public money" and for what particular "public goods" are still awaited.



Figure 3 - BPS reductions predicted effect on farms net margins (2020-2027)

Staff Requirements

Table 9 shows the labour hours required for each operation (average and premium) and the number of hectares for each operation. These values are calculated using the standard values reported in Nix (2020). With this information it is possible to estimate the number of staff hours needed for all operation.

Table 9 - Staff requirements per on farm operation (using standard values reported in Nix 2020)

	Labour Hours		Operations	Labour	Labour	Month(a)
Operations	(per na) average	Premium	Performed (ha)	Hours (Ava.)	⊓ours (Premium)	`Performed
			(10)	(*** 3*)	(1.1.0.1.1.0.1.1)	
Ploughing	1.4	1.0	107	150	107	July to October
Cubacil	1.0	0.7	0	0	0	September to
Subsoli	1.0	0.7	0	0	0	October September to
cultivation	1.0	0.7	238	238	167	October
						September to
Power harrow	1.0	0.7	0	0	0	October
						September to
Press	1.0	0.7	345	345	242	October
Drill (coroale						Mid Sept - 3rd
conventional)	1 1	0.7	345	380	242	Oct-Nov
Rape drill with		011	0.10			
subsoil	1.1	0.7	111	122	78	September
Roll (include in						September to
drilling)	0.0	0.0	0	0	0	October
Fertiliser &						
application						
Fertiliser application	0.3	0.2	1394	418	279	April-July
Sproving	0.3	0.2	955	256	171	October -
Top Dress (3	0.3	0.2	600	200	171	November
times)	0.9	0.6	1139	1026	684	March - April
Spray (3 or 4)	1.0	0.5	855	855	427	May - June
Slug-pelleting	0.3	0.2	346	104	69	October
Harvesting						
						Mid Aug - Early
Combining	2.5	1.9	456	1141	867	Sept.
Baling						
Straw Baling and						Mid Aug -
carting	4.8	3.4	238	1143	810	September
Carting, drying, storage						
Grain						Mid Aug - Early
Carting/Haulage	2.5	1.9	456	1141	867	Sept
Total	20.2	14.1	6885	7317	5008	

Table 12 shows the staff requirements for these operations by month.

Table 10 – Monthly staff requirements for NUFarms

			Estimated s	taff requirements*
Month	Labour Hours (Avg)	Labour Hours (Premium)	Avg	Premium
January	0	0	0	0
February	0	0	0	0
March	513	342	3	2
April	617	412	3	2
May	532	283	3	2
June	532	283	3	2
July	142	96	1	1
August	1,750	1,298	10	7
September	2,290	1,661	13	9
October	687	466	4	3
November	255	166	1	1
December	0	0	0	0
Total	7,317	5,008	3	2
*. Staff requirements a	re calculated by	assuming 180 hour	rs in a standard	d "man" month.



Figure 4 – "Manhattan profile" showing the estimated monthly staffing requirements.

Figure 4 shows the high demand for labour in August and September. To some extend this is a result of the calculation methodology which assumes overtime is spread across the entire year, rather than concentrated at periods of peak labour demand. However, the profile is not untypical of arable farms, and Figure 4 provides a useful view of the need to augment regular staff with part-time, perhaps student labour, at this time of the year.

Figure 4 also compares the importance of good staff. In September, three additional staff are needed if 'average' rather than 'premium' staff is used in the calculation. This highlights the need to retain good staff.

Therefore, I recommend that for the cereals operation the farm requires two full-time salaried staff, but that during the busy harvest months of August and September, the farm takes on three additional harvest workers – perhaps on an hourly basis. The cost of this is calculated in Table 11 – based on standard labour costs (Redman, 2020). If the staffing costs are subtracted from the "operational net" margin for 2021 (of £280,008) the arable enterprises would return a profit of £213,387.

Worker	Salary	August	September	Total
1	£27,837.00	£0.00	£0.00	£27,837.00
2	£27,837.00	£0.00	£0.00	£27,837.00
3	£0.00	£1,894.20	£1,754.80	£3,649.00
4	£0.00	£1,894.20	£1,754.80	£3,649.00
5	£0.00	£1,894.20	£1,754.80	£3,649.00
Total				£66,621.00

Table 11 - Estimated staff cost (based on staff costs presented in Nix 2020)

Selected Machinery Replacement Schedule

Name	Cost	Disposed	Owned	Estimated Value	Depreciation	Replace
Drill - JD 750a	£70,000.00	2030	12	£32,843.34	£37,156.66	Yes
Kuhn/Accord Combi	£12,200.00	2021	11	£12,149.18	£50.82	Yes
Kverneland Fertiliser Spreader	£16,500.00	2029	10	£8,412.47	£8,087.53	Yes
Opico Roller	£10,250.00	Кеер	Keep			Keep
Plough - Lemken	£6,000.00	2024	20	£4,640.47	£1,359.53	Yes
Scraper Tractor MF65	£1,500.00	2021		£1,487.30	£12.70	No
Tractor JD 6100	£9,000.00	2031	12	£3,111.53	£5,888.47	Yes
Tractor JD 6215R	£98,000.00	Keep	Keep			Keep
Tractor JD 6930	£46,000.00	2023	12	£37,129.65	£8,870.35	Yes
Tractor JD 7530	£47,800.00	2024	20	£34,704.18	£13,095.82	Yes
Tractor MF375	£7,500.00	2021		£7,436.48	£63.52	No
Tractor NH T7.200 - NK65AUF	£74,767.00	2025	10	£48,899.03	£25,867.97	Yes
Bailey Trailer 12t	£14,000.00	2027	13	£8,447.88	£5,552.12	Yes
Bailey Trailer 12t	£11,300.00	2026	17	£7,420.82	£3,879.18	Yes
Bailey Trailer 12t	£8,850.00	2026	19	£5,806.07	£3,043.93	Yes
Bailey Trailer 12t	£14,000.00	2028	14	£1,792.41	£12,207.59	Yes
Slug Pelleters	£3,235.00	Keep	Keep			Keep

Table 12 – Recommended machinery replacement schedule

Table 13 shows the recommended machinery replacement schedule (using Nix's (2020) estimated machinery useful life. The replacement year has been adjusted to help to spread the cost of buying new machinery between years 2021-2031.

It may make sense to sell the Kuhn Combi (but see below) and two Masseys Fergusons tractors in the first year. They appear to be surplus to requirements.

The annual depreciation for each item of equipment is shown in the Table. The equipment that should be retained will last over the ten years (for example, a tractor doing less than 500

hours a year should last twenty plus years.) This is advice is given unaware of current warranties on these items, so it may be that the cost of repairs on older pieces of equipment will make it more financially viable to buy replacements earlier.

Benchmarking the arable operations

Currently NUFarms does not use AHDB Benchmark online tool – I recommend that it starts to do so. However, Table 15 benchmarks NUFarms against the contractor costs published by the National Association of Agricultural Contractors (2020).

Name	Total Cost per Ha	Contractor Charge per ha	Savings by Owning
Drill - JD 750a	35.29	58.72	23.43
Kuhn/Accord Combi	871.83	57.72	-814.11
Kverneland Fertiliser Spreader	2.59	12.31	9.72
<u>Opico</u> Roller	2.44	18.03	15.59
Plough - Lemken	12.78	66.86	54.08
Scraper Tractor MF65	239.77	38.12	-201.65
Tractor JD 6100	17.6	38.12	20.52
Tractor JD 6215R	41.27	43.32	2.05
Tractor JD 6930	23.43	43.22	19.79
Tractor JD 7530	29.5	55.76	26.26
Tractor MF375	1139.77	38.12	-1101.65
Tractor NH T7.200 - NK65AUF	27.82	42.32	14.5

Table 13 - Benchmarking Equipment against Contractor Costs

As can be seen in the "savings by owning (the item of equipment)" column, it does not make economic sense to retain the Combi drill and two Massey Ferguson Tractors. The farm is better off owning all other items of equipment. It is estimate that the combi drill will not be sufficiently used in a minimum tillage cultivation system, but it may still be useful tool in wet year. Therefore, in practice, and given it low second-hand value, I would recommend retaining this item of equipment for the time being, and reconsidering this decision in two years.

References

Agriculture and Horticulture Development Board (2020) *Business Impact Calculator*. Available at: <u>https://bic.ahdb.org.uk/Calculator</u> (Accessed:14/12/20)

GOV.UK (2019) *AB6: Enhanced Overwinter Stubble*. Available at: <u>https://www.gov.uk/countryside-stewardship-grants/enhanced-overwinter-stubble-ab6</u> (Accessed: 14/12/2020)

National Association of Agricultural Contractors (2020) *Contracting Prices Guide 2020*. Available at: <u>https://www.naac.co.uk/wp-content/uploads/2020/09/NAAC-Contracting-Prices-Guide-2020_v2.pdf</u> (Accessed: 14/12/2020)

Nix, G. (2020) *The John Nix Pocketbook for Farm Management 2021*. 51st Edition. Published: Melton Mowbray: Agro Business Consultants.

RPA (2021) Enhanced Overwinter Stubble.

https://www.gov.uk/countryside-stewardship-grants/enhanced-overwinter-stubble-ab6

This assignment requests students present an invoice detailing the work done and the charge the student would make for that work done. No advice is given to the students in producing this invoice. The aim is to encourage students to consider the economic value of employing advisors and to help them assess the value their work has added to the case study farm.

INVOICE No: 001

R Oliver Farm Planning

Fenn Lane Farm Upton, CV13 6BL No: 07813880784 Supply Date: 15/12/2020

Invoice Date: 15/12/2020 Due Date: 15/01/2021

BILL TO	FOR Farm Report
James Standen NU Farms Cockle Park Farm, Ulgham Northumberland, NE61 3EA	
Details	AMOUNT
Work Time	£100.00
Farm Report	£50.00
Spreadsheet	£25.00
Other	£0.00
SUBTOTAL	£175.00
VAT 20%	£35.00
OTHER	£0.00
TOTAL	£210.00

Make all checks payable to R Oliver Farm Planning

If you have any questions concerning this invoice, use the following contact information:

Phone: 07813880784 Email: r.oliver3@newcastle.ac.uk

THANK YOU FOR YOUR BUSINESS!