

Mechanization Needs for Revitalization of Vancouver Island Vegetable Farming

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Nanoose Edibles Farm

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Introduction

The Heritage Food Services Co-op, as originally envisaged, has good prospects for revitalization of agriculture in the Nanaimo Regional District and as a model for Vancouver Island. There is a shortage of experienced and committed labor but particularly a lack of appropriate mechanization to minimize cost of production and enable scaling up from gardening to small-scale farming. Appropriate equipment could help reduce farming to a more normal work-week. Our farmers have had little opportunity to see and test specialized equipment for applicability to their operation. Formation of an ancillary equipment co-op could serve this need, share the risks and help quickly scale up production. I have given considerable study to equipment and present some ideas here. Hopefully this will encourage co-op members to meet and quickly get some active discussion going so that everyone can contribute their equipment needs and ideas.

It is suggested that this outline be quickly read as an ideas stimulant and then a second pass be made, selecting the web links provided for detailed information.

Vancouver Island agriculture has failed under the B.C. Ministry of Agriculture's emphasis on marketing with a lack of attention to costs of production and production systems. On-farm extension has ceased to exist. The agriculture industry has been allowed to decline to the point that few can or want to participate. The Ministry states our farmers are highly efficient. That is false for row-crop vegetable production, with few exceptions. A case should now be made for assistance grants for community-shared mechanization.

I believe that assistance with mechanization should first target the numerous potential, ±5-acre sized, diversified farms. There is need to revitalize the many small farms that have recently given up. The larger farms can more easily take care of themselves, and usually specialize in fewer crops. Equipment discussed will include the small tools individual farms may choose to own to compliment more expensive shared equipment. Organization, structure and financing of equipment co-ops will be discussed later.

Most farms have a tractor and implements for land preparation for cropping and larger area weed control or can have custom work done. The need is for specialized equipment and opportunities to see and evaluate alternative models and systems. A system should integrate seeding, transplanting, frequent precision weed control, crop maintenance and harvesting, flail chopping of crop residue for sequential cropping, cover crop seeding.

It needs emphasizing, that 3-point, rear mounting is the simplest but dumbest location for row-crop tillage equipment. If you move into the crop row you have to steer away. The tail-out geometry then moves the implement into the crop, the opposite of the result desired. Large farms employ GPS and Autosteer, and then need camera sensing, hydraulic implement guidance to keep out of the crop. For small-farms it seems sensible to use mid- or front-mount implements so that front wheels and implements both point in the same direction.

None of the North American systems of large tractor, large rear mount equipment fit the needs of portability between-small farm and maneuverability for short rows. Equipment does have to be large enough to get jobs done quickly and move on to the next farms, all of which need servicing at nearly the same time.

Motive Power

Unaided human power lacks the efficiency to significantly scale up production but hand tools will always be needed to fine-tune crop maintenance. A step up is the wheel hoe with its range of accessories, claimed by the maker to increase efficiency ten-fold. Nanoose Edibles has two Swiss Glaser hoes, a single wheel for between-row and a double wheel to straddle and close cultivate crop rows. Efficiency depends upon timely application and some stamina. As an example, in one unique year with one unique individual 2 to 3 acres of vegetables plantings were maintained by wheel hoe at Nanoose Edibles without any hands and knees weeding, this has never been repeated.



Photo 1. Glaser wheel hoe, one and two wheel configurations and various attachments Two wheel hoes \$400 each plus \$750 for tool set.

The next step is the two-wheel, walking tractor systems, for example the single use Troy rototiller. The versatility and range of equipment capability of walking tractor systems is illustrated in www.ferrari-tractors.com/walking.htm. The California proprietor told me by telephone that there were surprisingly large numbers of small farms in that large-farm



state. There are advantages to working from the ground, however the walking tractor systems do not contribute much to vegetable crop maintenance as the wheels do not span bed widths. Thus walking tractors do not seem to offer much help for large increases in production. They would be great for urban gardening of vacant lots.

Photo 2. Hermes Flail Mower and walking tractor. Useful for removing crop residue, walking tractor \$6000, flail mower \$2200.

Row crop tractors are designed to facilitate culture of single beds. Nanoose Edibles has a International Harvester - Super A with offset engine with high clearance, circa 1950. The Super A has the advantage of belly- mounted hydraulics where implements can be closely watched by the operator. However, erratic steering, lack of low enough speed, wide turning radius, make it inappropriate for our 40-50m length beds. The similar vintage Allis Chalmers model G, has a rear mount engine and also features mid-mount implements. Modern prototypes have been developed including the Saukville (www.saukvilletractor.com) and the tuff-bilt (www.tuff-bilt.com). Both utilize hydrostatic transmissions. The latter manufacturer specializes in keeping costs low, has developed electric models and boasts accommodation of 20+ implements and accessories.



Photo 3. Saukville, Allis Chalmers Model G Replica



Photo 4. Tuff-Bilt AC Model G replica

The Swedish Mastrac (www.mastrac.se) is a wide versatility, new concept, small tractor advertised to serve as both a row crop and a highly muscular utility tractor. It has four-wheel drive with hydraulic wheel motors independently powering each wheel. Articulated steering provides ± 1 cm steering accuracy and ability to turn back on its own track to easily enter adjacent beds. A front lift and quick attach system mounts implements where they can be seen and controlled. A rear 3-point hitch is available. Farms associated with the factory find it easy to closely cultivate at 8-day intervals. Farm size using it ranges from 0.75 to 70 hectares, including Sweden's largest carrot grower. It has been 5 years in development and in service three years. Price is about \$27,000 Canadian with the inflated Eurodollar. I think it would pay its way.



Different wheels



Different weeding tools



Weeding brushes



Weeding with this machine enables you the opportunity to take away the weeds very close to the crops. The construction of the machine make this work very easy and efficient.

Photo 5. MacTrac tractor and supporting weeding machinery. tractor price \$27,000

For environmental considerations, a California innovator (www.renewables.com) offers an electric wheel motor tractor design that could serve a small farm all day before recharging. However, it carries the North American rear mount design hang-ups. I suggested the two firms collaborate. Electric motive power seems adaptable for self-propelling equipment.

Table 1 compares the critical specifications and pricing of the two Model G type tractors and the Mastrac. Both systems should be procured and put to the test on Vancouver Island.

Trail to the Mactrac came through the manufacturers previous product, the lay down / sit up work cart called the Drängen (Swedish for farmhand). This machine has found its way to several areas in the U.S. This is a rubber-tracked, small motor machine which accommodates one to several workers in a procumbent position for weeding, hand transplanting and harvesting. It can be used with a seat for cultivation and other “farmhand” uses. A Oregon couple I talked to pronounced it to be “Great, better than bending”. Its creep work speed makes it slow to move between work areas. They use the Drängen work cart and their AC model G to vegetable farm on 17 acres, without hired labor. The Drängen should be regarded as a supplement to a main tractor.



Photo 6. Drängen Work Cart, \$11,000

It will be of interest that the Oregon contact led Nanoose Edibles to a used Drängen, which has been purchased and should be delivered soon for evaluation by our farm and by co-op members.

Table 1. Operating specifications of three small row crop tractors

	Saukville Model G replica	Tuff-bilt Model G replica	Mactrac
Where built	Wisconsin	Arkansas	Sweden
Engine location	rear	rear	rear
Wheel width adjust.	40-60" std Wider in dev.	front 38-60" Rear 36-46"	46-71"
Ground clearance	18-21" st 27" HB model	20"	~ 18"
Wheelbase	84"	72"	?
Length	144.3"	115"	90.6"
Width	96"	?	wide range
Weight	2500 lb	1300 lb	1694 lb
Turning radius	?	84"	zero
Turning brakes	yes	yes	not needed?
Steering	power	power	power,articulated
Hitches	front & rear, cat.1	front & rear, cat 0	f & r quick attach. attach
Lift cap.	?	700 lb each	616 lb
Tires, Rear	42', 8.3 x 24 5.00 x 12	8.3 x 24 4.00 x 12	8" wide, 10.5" rim? Front same as rear
Engines,HP	20 & 25 air cooled ga 23.5, water cooled gas	18 hp air cooled, gas, Electric drive avail. 25.5 & 26.5 diesel	18 or 25, gas 17 or 35, diesel
Transmission	hydrostatic	hydrostatic	hydraulic wheel motors
Travel speed	creep to transport	0-12 mph	0-25 mph
Price, Can. Funds	\$18,000 gas \$23,000 diesel	\$11,000 gas	\$27,000, diesel

Note: Some specifications were not available or need to be confirmed. See websites for more detail.

Seeding and Transplant Equipment



The most critical implement need is for multi-row, single bed, crop establishment tools that will plant in very straight, parallel rows and beds. This is the precursor to efficient machine weeding. Ideally, equipment should be self-propelled, such as the multi-row, single bed, walk behind Miniair Profi vacuum seeder, powered by a 5HP Honda, made in Holland using the German Accord - Super, seeding units (www.miniair.nl). There are several models.

Photo 7. Self propelled model 620 vacuum seeder. Price \$14,000

Nanoose Edibles has a tractor drawn precursor model Fahse Miniair that is being re-assembled after use in bare-root forest nurseries. It has done a good job with some vegetable seeds, such as carrots, but still lacks the correct seed disks for other vegetables, such as beets. Irregular shaped seed may have to be pelleted. A problem has been that when the drill is needed for a small seeding jobs other higher need implements are already mounted on the tractor, hence the stand-alone self-propelled seeder ideal. Vacuum seeders require special technique and are expensive. Other tractor drawn, vacuum seeders are offered in Market Farm Implements catalog http://www.marketfarm.com/online_catalog.cfm.



Photo 8. Fahse miniair Vacuum Seeder, set up for three rows.

The New Zealand Spider Rocket seeder uses a new seed distribution system that merits testing. Seeds are drilled out by a 12 volt sponge rotor in a regulated stream, with seeding rate dependant on traveling speed Multiple units may be hand or light toolbar drawn. The spider rocket offers simplicity of use and is light for portability between farms. More information and demonstrations can be obtained at their website. <http://www.seedspider.com>



Photo 9. Spider rocket seeder hand or tractor drawn. Price \$4,400

Larger sled or roller Spider seeders sow 6 rows per electronic distribution unit and seem ideal for high row numbers of high density greens crops seeding, also for establishing small seeded legume cover crops. Cover crops are hard to establish with certainty, yet are critical for soil fertility maintenance under organic culture.

It is hard to evaluate the cheaper, plate or disk mechanical, multi-row seeders offered in the Market Farm Implements catalog without seeing and testing them. The popular plastic Earthway Seeder performs well, with careful use, on our farm for single rows but is too erratic and prone to skip when linked for multi-row use. Nanoose Edibles tried a single row Korean seeder. However, despite promising seed singulation, it had too many seeding failures to risk purchase of a multi-row version. The dealer in Ontario visited our farm and stated we were the only sale with a reported problem. It needs more testing. Seeding is so important and specialized that the available seeders need short listing and comparison testing. For community use the qualities of versatility, seed economy, reliability and speed of servicing many farms should be the foremost considerations with price being a secondary issue.

More efficient transplanting was the need expressed by the few farmers talked to so far, particularly if operating without hired labor. Hand transplanting jobs always seem hard to finish. There is a wide choice of tractor drawn, single row per operator transplanters. These are all priced at about \$3000 per row but four workers are needed for a three-row bed. Checci & Magli and Sfoggia, both Italian, offer new models in which one operator can handle two staggered rows. Price is a disproportional \$12,000 per two row unit.

Harvesting equipment

The Swedish Drängen work cart at \$11,000 Canadian has already been mentioned. My Oregon contacts said it works well for cucumbers. Mexican farm workers did not like it because it slowed down strawberry picking piecework to the slowest pace worker on a cart of four workers. There are smaller (fewer beds covered) versions of the huge conveyer systems used on large farms, for example, www.nabersequipment.com. Multi-row greens harvesters are used by large corporations to flood the market with cheap but inferior varieties of bagged greens. Ferrari Tractor now offers a scaled back, single bed, walk behind, battery- powered model that could be used to reduce cost of production, if used selectively to maintain hand crafted quality. Whatever the system, hand or mechanized, zero weed tolerance must be attained. The automatic sweet corn, bean, carrot, etc. harvesters keep getting bigger and more expensive, and do not fit small Vancouver Island fields. Equipment must be highway portable. Smaller, “entry level” harvesting machines are advertised and worth watching for.

Photo 10. Self propelled, electric greens harvester. Price \$8,500.



This is where specialization is needed as part of revitalization, for example potato production. Willsie Equipment Sales, Inc., in Ontario, manufacture interesting low cost root crop harvesting equipment (www.willsie.com). There are a lot of useful tools we know nothing about. That must change to get revitalization of Island vegetable production underway.



Photo 11. Root crop harvester

Other equipment and ideas

There are many opportunities to increase productivity and decrease labor inputs using specialized equipment. The \pm 5 acre vegetable farm could benefit from state of the art bed shapers, with remay - plastic mulch laying and drip irrigation line laying capabilities. In developing our farm, the first items of fabrication were manual rock forks to efficiently pitch cobbles into the front-end loader.

Several custom tractor rock pickers failed to do a good job and sacrificed too much topsoil. Braber Equipment offers the Agrimurge tractor-drawn rock crusher with a 20cm depth capacity that turns the rock into mineral rich powder. Such expensive equipment is impractical for individual farms to own but could make sense for an equipment co-op. Another large example is the drainage plow procured by the Courtenay District Farmers Institute.



Photo 12. Agrimurge rock crusher requires 100 hp tractor. price \$40,000.

We need ideas and formalized discussion from everyone. What are the needs of your farm? How many hours would you need specialized equipment, how many days a week, what proportion of the growing season would it be idle and possibly available for community rental use? Perhaps there is a need for a mobile operator who would trailer equipment around and maintain and help optimize. Perhaps farm owned equipment could be rented on the “Good Neighbor” system of replacement cost and anticipated hours of use. Should it be policy that equipment is never loaned free but should have a calculated rental value. Perhaps some of us would share equipment on a rental basis. Our farm has an equipment list that could be updated. Could your farm produce such lists?

Equipment Co-op Organization

The first need is to understand the components of farm machinery costs, replacement (new), depreciation, fixed and variable costs. A series of joint B.C. Ministry of Agriculture and Canada Agriculture bulletins provided this in an easy to understand few pages. These are undated and apparently out of print and could not be located. I finally rediscovered my set but had been directed to newer Ontario Ministry of Agriculture Food and Rural Affairs publications that cover these subjects and their calculations in greater detail. The web site for this series is www.omafra.gov.on.ca/english/busdev/facts/

The Center for the Study of Co-operatives at the University of Saskatchewan covers every aspect of co-operatives. Several publications by Andrea Harris and Murray Fulton cover farm machinery co-ops. The Saskatchewan examples are for huge grain farming tools and 2.3 square mile farms. However the principles are the same for scaling down to small Vancouver Island farms. The websites and most relevant publications are listed below:

http://coop-studies.usask.ca/publications/electronic_format

[*Farm Machinery Co-operatives: An Idea Worth Sharing.*](#) Andrea Harris and Murray Fulton (48pp.), 2000.

[*Farm Machinery Co-operatives in Saskatchewan and Québec.*](#) Andrea Harris and Murray Fulton (42pp.), 2000.

[*The CUMA Farm Machinery Co-operatives.*](#) Andrea Harris and Murray Fulton (46pp.), 2000.

In the most common farm machinery co-op the entire machinery sets are pooled among all members. This is the common form in Saskatchewan. A newer system that has evolved into widespread use in France and become accepted in Quebec is the CUMA. (Coopérative d'Utilisation de Matériel Agricole). CUMAs are structured to allow the sharing of individual machines among subsets of members. This is facilitated through the use of activity branches and subset member contracts. As of year 2000, more than a thousand farm operations have become members in the more than forty- seven CUMAs in Quebec and one in Ontario.

The advantage of the CUMA is that members have responsibility only for the machinery they are interested in. This means that all types of farms, animal as well as vegetable, can have their specialized needs accommodated under the same equipment co-op. The structure of the CUMA is shown in Figure 1 on the following page. Details of machinery co-ops are well explained in the three down loadable University of Saskatchewan publications listed above.

Details of what machinery, distances between farms, transport, maintenance and repair, finance, scheduling would all have to be worked out, probably best through a series of potential member workshops.

Considerable standardization is needed for row crop production, such as width of beds and number of crop rows. Nanoose Edibles uses a 48" bed width because our tractor is 48" between wheel centers. However, the larger farm standard is usually 60" or 72." The set up time between uses and farms obviously has to be minimized.

The machinery co-op would have to own transport equipment, such as trailers and specialized trucks. Small machinery can be efficiently swung off and on to the small imported trucks with their build in hydraulic hoists. Our farm has utilized a friends unit on a number of occasions, such as for large coolers.

Not all farmers are good at maintenance at the high standard expected for shared equipment. Members would need to understand optimization. A reading of the manual would be a minimum requirement, along with patience needed to build competence beyond the 85% level. Realistically farmers do not need extra detail when their time is more than 100% over-committed. This is where the co-op could assist.

Depending on scale, the machinery co-op would need staff to organize, schedule, maintain and transport equipment. A good model comes from a British employment scheme, probably set up during the mid 20's depression. Several ± 400 acre farms were divided into 14- acre farms and a committed family installed, each with a residence. These units were not allowed to have tractors or heavy equipment but would telephone the overall equipment manager when they needed service. Apparently a couple of these multi-farms still exist.

activity branch corresponds to the use of one machine, piece of equipment, or service. A minimum of three members per branch is recommended.

Figure 1 shows the organizational structure of a hypothetical CUMA farm machinery co-op organized into three activity branches. Each activity branch corresponds to a different machine or farm operation, in this case a hay baler, a seed drill, and a forage harvester.

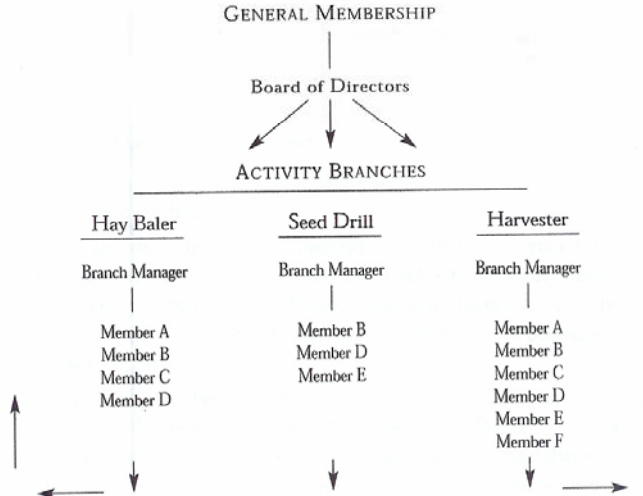


Figure 1: Organizational Structure of a CUMA

Upon joining an activity branch, all members must sign a subscription contract, which commits them to using the particular piece of equipment for a specific amount of time, or number of units, per year for the duration of the contract. The duration of the contract is typically the same as the length of time over which the machine is being financed (usually three to five years). A sample subscription contract is provided in Appendix A.

Figure 1. Organizational structure of a hypothetical CUMA farm machinery co-op. Reproduced from Harris and Fulton 2000, with the kind permission of the Center for the Study of Co-operatives, University of Saskatchewan.

Similarly, our aspiring farmers, without capital, could get a start on underutilized land and depend on the co-op for their machinery. A climate for successful agriculture would eventually enable their expansion. A co-op equipment manager, with assistants, could manage the maintenance, transport and farmer training and optimization of the co-op assets. The co-op maintenance shop could serve for fabrication of special tools. The co-op could also serve as dealer for the esoteric machinery not represented to date on Vancouver Island. This could reduce costs and facilitate demonstration and availability. This sales component has a parallel with the value-chain organization seen in Co-op Atlantic.

Financing

Early information needed is for potential members to evaluate the hours and seasons of use of individual machines on their own farm, hours available for rental to the co-op, and value of equipment they already own. This then could be the nucleus of equipment availability and the basis for any matching community or government grants. Grants should be sought since society most definitely owes it to the industry. However, farmers as usual, need to be prepared to pay their own way

Potential members would make a priority list of new equipment which could pay its way on their farm and pooled lists would in turn determine the equipment co-ops priority and the number of members sharing the purchase and operating costs.

Conclusion

Specialized farm machinery plays a critical roll in revitalizing the Vancouver Island farm industry. Intelligent mechanization allows the farmer to increase productivity and reach a standard of living expected in our society. It is critical that farming become a productive and desirable lifestyle to ensure regional food security and environmental sustainability. Machinery co-operatives may play a critical role in jump-starting this process and ensuring new farmers can enter the industry.