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Fifth Joint Conference on

Agriculture, Food and the Environment

Proceedings of a Conference Sponsored by
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Universita degli Studi di Padova
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SESSION V: COMPUTER SCIENCE AND ENVIRONMENTAL MANAGEMENT

PAPER 3: MANURE APPLICATION PLANNER (MAP): CONVERSION AND USE IN ITALY

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5th JOINT CONFERENCE ON AGRICULTURE, FOOD AND THE ENVIRONMENT

Manure Application Planner (MAP): Conversion and Use in Italy

by

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Abano Terme - Padova, 17th - 18th June 1996
ITALY

MANURE APPLICATION PLANNER (MAP): CONVERSION AND USE IN ITALY

Antonio Boggia and Wynn Richardson*

1. Introduction

Many farmers are concerned about the environmental impact of their farming operations. For livestock producers, a primary concern is proper manure utilization and handling. A manure application plan needs to be developed by livestock producers as a means of accountability for their manure management. A manure management plan is a specific set of practices and recommendations developed for a specific farm. These plans would include such items as the application rate, method of application, time of application, etc. By having this type of plan, manure applications could be made that are appropriate and acceptable according to the set of conditions for a given locale.

Producers are equally concerned, however, about the financial status of their farm business. Any manure management plan must also include an economic assessment as well as traditional agronomic considerations.

The Manure Application Planner (MAP), version 3.0 was written and released by the Center for Farm Financial Management at the University of Minnesota to address both the agronomic and economic components of a manure management plan. The software utilizes a mixed-integer form of linear programming, which is a proven optimization routine for manure planning (Schmitt et al., 1994a) and other agricultural applications (Beneke and Winterboer, 1973). This optimization allows an application plan to be easily developed if a farmer does not have an existing application plan. However, if the producer does have an existing plan, the software can also be used to assess the plan and easily make modifications for environmental or economic concerns.

2. History and use of MAP

2.1. History

MAP version 3.0 was developed as a joint project among the Minnesota Extension Service, the Minnesota Natural Resources Conservation Service (NRCS), and the Minnesota Pollution Control Agency (MPCA). Due to this joint support, permitting of farms according to the Minnesota feedlot ordinance and cost-share programs can be

* This paper arises from the common work of the authors in the project for the implementation of an Italian Version of MAP. W. Richardson wrote section 1, 2 and 3; A. Boggia wrote section 4, 5, 6 and 7.

validated by the software's output for the MPCA and the NRCS, respectively.

Besides the use in Minnesota, the Southwestern Illinois Resource Conservation and Development, Inc., and the Illinois Natural Resources Conservation Service also supported the development of version 3.0. These agencies, along with the Illinois Cooperative Extension Service, also use the software to assist farmers with manure application planning.

2.2. Use of Manure Application Planner

As of April, 1996, there are over 340 copies of MAP in use in the United States and Canada. The distribution of these copies by group is shown in Table 1.

Type of User	Number of Copies
Extension	128
NRCS	69
Private business	44
Public agencies	39
Farm management instructors	24
Farmers/ranchers	20
University teaching/research	18

Table 1. MAP Users in the United States/Canada

Since version 3.0 was initially released in September, 1995, the number of copies has more than doubled. This large increase in MAP use may be due in part to recent large manure spills and the resulting media coverage. As people in the United States continue to move to developments or land that border livestock operations, the interaction of farming and nonfarming residents creates an atmosphere in which manure management is a large issue. This close proximity between livestock operations and other residents also exists in Italy, thus the need for a planning tool for Italian conditions that will assist farmers in making manure management decisions.

3. Software Organization

The software is written in Borland Pascal 7.0 and requires an IBM-PC or 100% compatible computer with MS-DOS/PC-DOS 5.0 or higher. The computer also must have an 80386 or later processor, at least 2 megabytes of RAM, one 3.5 inch diskette drive, and a hard drive with 2 megabytes of free space.

MAP allows for site-specific information to be input, thus making it adaptable for many geographical regions. After initializing the software, the main menu allows the user to go into file creation/management and then into a series of input and output menus. These main menu options will be discussed in the following paragraphs.

Manure Source Input

For whole-farm nutrient planning, the amount of nutrients contained in the farm's manure supply needs to be quantified. For each source/storage facility of manure, the nutrient content from a laboratory analysis and the amount of manure that is available for spreading on an annual basis allows the software to calculate the farm's nutrient supply. If this information is not available for input, the software can estimate manure/nutrient amounts and concentrations using daily manure/nutrient excretion data and average N loss from the storage facility (Midwest Plan Service-18, 1993).

Users of the software should be encouraged to use manure testing regularly due to the wide variation in analyses from seemingly similar livestock operations (Wagar et al., 1994). Manure volume, or quantity, should be calculated from measured storage capacities rather than excretion data because of changes during the handling and storage phases. The manure estimation feature was included primarily for new operations to provide an initial basis for manure management planning.

Field Input

Crop yields are often dependent on the supply of soil nutrients; therefore, the livestock aspects of an enterprise form the nutrient supply and the cropping aspects of the operation form the nutrient demand. Each field is unique in terms of its nutrient demand, or recommendation, because of the cropping rotation, soil test values, and production capacity. Each field's nutrient needs, independent of nutrient source, must be entered individually in the software.

These nutrient needs, or recommendations, form the starting point in calculating the fertilizer replacement value of manure that might be applied to the field. The economic savings from the manure cannot be greater than the costs of the nutrients recommended. The user has the option of using any laboratory's N-P_2O_5-K_2O recommendation. The user also has the option of allowing the software to provide information to calculate a nutrient recommendation based solely on crop removal using crop and yield levels. While this procedure is not encouraged, previous experience by the authors has been that many producers use this method in determining nutrient needs.

To establish environmental guidelines for manure/nutrient applications for each field, the user selects the crop to be grown on a field, which in turn indicates whether the crop is a legume or not, and enters the maximum amount of phosphorus (P_2O_5) that can be applied to the field. The legume information then becomes the initial criterion for N application limits on a field. If the crop is a non-legume, N will be applied to meet the recommendation with no excess available N allowed. If the crop is a legume, the N recommendation is generally zero, but the software then allows manure to be applied to meet the P_2O_5 recommendation under the presumption that the legume will take up the added N with a compensatory decline in N_2 fixation (Peterson and Russelle, 1991; Schmitt et al., 1994b).

The software defaults to a P-based application rate, which allows the maximum P_2O_5 amount being applied to equal the recommended amount of P_2O_5. However, users can decide if the manure application rate should be N- or P_2O_5-based, or somewhere in between by entering a maximum P_2O_5 allowable limit. Producers should follow local guidelines in restricting excess P_2O_5 applications when near surface waters, when erosion potential is high, and/or when soil P test values are very high.

An optional entry for each field is selecting the method of manure application. The method of manure application has a direct effect on N loss and N availability, especially in the year of application (Figure 1).

Application Methods   Screen 1 of 4

Manure Type Beef

Application Method	-----% N Available------			% Available	
	Year 1	Year 2	Year 3	P2O5	K2O
Bdcast, inc < 12 hrs	60	25	10	80	90
Bdcast, inc < 4 days	45	25	10	80	90
Broadcast, no incorp	25	25	10	80	90
Knife injection	50	25	15	80	90
Sweep injection	60	25	10	80	90
	-	-	-	-	-

PgDn Next Screen   PgUp Prev Screen   <Alt> D Delete
F1 Help   <Ctrl> A Exit, Don't Save   F10 Menu

Figure 1: Example of application methods screen.

While the software has the option of selecting a method of manure application for each field based solely on the N recommendations and economics, we expect that most producers will select specific methods for their fields based on their method of manure handling, the crop, time of application, and/or available equipment.

The distance between the field and the manure source also must be entered for each field. This distance will be important in prioritizing manure applications because of the associated hauling costs.

Economic Input

Economic input is critical in the formulation of the manure management plan created by the software. Fertilizer costs for N-P_2O_5-K_2O are entered as well as a representative application charges for these materials. Combining these costs and the fertilizer recommendations for each field provide the maximum economic value of the manure for each field.

Manure application and hauling costs also should be entered in this section. Manure application costs are a function of application equipment, incorporation operations (if any), and size of equipment, whereas the hauling costs are dependent on the distance to the field and size of tractor. Defaults are provided based on economic datasets for equipment and labor costs (Lazarus, 1996) such that application costs are simply based on method of application/incorporation and hauling costs are dependent on distance to the field. We expect and encourage users to modify these costs to fit the specifics of each individual farm.

Optimization Process

After completion of data entry for the manure supply, crop demand, and economics sections, the software calculates manure application rates for all fields concurrently to optimize the economic value of the manure. This optimization uses a mixed-integer programming algorithm to meet the constraints set forth in the software. These constraints are: 1) the fertilizer recommendations must be met, either from manure or commercial fertilizer sources; 2) for non-legume crops, the amount of N applied cannot exceed the N fertilizer recommendation; 3) the amount of P_2O_5 applied cannot exceed the maximum allowable limit for the field, which may be the P_2O_5 recommendation depending on the maximum allowable limit specified; and 4) as much of the manure as possible must be applied. The objective function of the optimization is to minimize all costs, both commercial fertilizer and manure application and hauling costs.

In meeting these constraints, an initial manure management plan is formulated for a farm. The majority of users, however, will want to fine-tune parts of this plan to meet some of the personal or logistic constraints unique to that operation. Therefore, each field's rate can be adjusted, with the resulting effects on nutrient excesses or supplemental fertilizer amounts depicted in the output section.

If the producer so chooses, the entire optimization process can be by-passed, with manure application rate and application method being entered along with the field input information. This option can be very useful in evaluating environmental and economic parameters of an existing plan.

Manure Application Output

All of the output can be provided to the user on the screen and/or via the printer. The output information is grouped by field-specific or farm-specific data. The field-specific output includes the manure application rate, supplemental fertilizer rates, if needed, and the quantity of excess nutrients applied, which are defined as the amount of available nutrients applied in excess of what the fertilizer recommendations are for that field. An economic summary also is calculated for each field with two scenarios. In the first, the economic summary is calculated according to the prescribed manure application plan. In the second scenario, the economic summary is calculated assuming no manure is available. The difference between these two scenarios shows the economic implications of using manure as a fertilizer source.

Whole-farm output information is primarily a compilation of the field-by-field information. A main, important exception to this is manure quantity produced/available on a farm compared to its recommended usage. If there is manure "left over" after all of the fields are accounted for, there becomes an environmental concern for this enterprise. Whole-farm economic summaries and supplemental fertilizer quantities needed are also presented.

The printed output also lists some of the parameters used to arrive at the final plans, such as nutrient availability coefficients, field nutrient recommendations, and manure production information. Because all of these parameters can be accessed and changed by the user, the printout allows for verification of these parameters.

4. Manure management issues in Italy

Wherever in Italy there is a discussion regarding the environmental problems connected with livestock, it always comes to the conclusion that a better, proper management of solid and liquid manure is needed. This means basically, that however much one looks at the negative environmental aspects, with livestock everything revolves around the problem of manure. And this problem is not just connected with the large volumes produced, but also, and especially, with their chemical-physical composition. Besides the odor and ammonia, the greatest worry is with soil and water pollution. This is where the necessity arises for the environmental planning and management of livestock.

Much is said about the nitrogen content of manure and the dangers of it leaching into groundwater. This is undoubtedly a risk to be taken into consideration; however, there is increasing debate as well about the danger of soil and watershed contamination from the growing percentage of heavy metals present, especially for hogs, due to the new trends in feeding. Another important question is that of nutrients. The manure problem is centered around the debate over what is the best form of treatment and disposal from an environmental point of view. Despite new proposals on the subject, at the present time it is impossible to establish what method of disposal best respects the environment. The trend, however, is to give greater attention to feed - it is obvious that the waste is highly dependent on what goes into the animal.

Very strictly connected with manure management is the problem of the odours.The situation is quite serious in Italy, if one considers that in some cases livestock farms are right next to towns. The lack of adequate regulations logically results in the matter being taken to court, where much is left to the discretionary power of the judges.

There are various options for manure management and treatment, but it should be said that wherever it is possible, especially where a careful, balanced diet is provided and water is used prudently, it is still preferable to use liquid and solid manure as fertilizer. This utilization of manure allows animal-breeding to be brought into closer connection with the land and crops. Of course this type of utilization strictly depends on quantities and soil type, and requires careful management. If the manure is not properly stored, processed and applied, the nutrients and fertilizing elements can be lost and sometimes become air, water and soil pollutants. Incorporating manure directly into the soil and applying it when the prevailing winds are not blowing towards populated areas may be other useful precautions. It is always important to treat liquid waste at the farm prior to spreading. Here, too, there are different possible choices, though this is not the appropriate place to list them. Generally, however, it is important to remember that the first step in the proper management of manure for spreading in the field is to have enough storage volume to make sure that spreading is done at the right times during the year, and not being forced to empty the tanks due to a lack of space.

In the past there was in Italy very much attention on an alternative to spreading manure in the field: the treatment of manure in centralized plants, generally cooperative purifiers. The problem, however, is that these plants do not eliminate the problem of spreading, because in any case the final product is part conditioned sludge and part water to be used for fertilization by irrigation. Other plants seem to be able to produce water which is practically drinkable, but the cost for treatment is very high. Generally, the main problem in all of these centralized plants is the high costs, which have negative repercussions on the producers.

At present, very much attention is given to the application of manure on the fields.

5. Need for MAP in Italy and software conversion

The protecting of physical resources in both urban and rural areas has been for some time the main objective of an environmental policy which aims at restoring and/or improving "environmental quality". This goal can be reached more easily today than in the past, due to the decreasing importance of agriculture devoted solely to greatest possible production of foodstuffs. This is the general framework of the activities of the Italian National Research Council (CNR) in the project RAISA, that is the funding source of the research that includes the Italian conversion of MAP.

The territorial reference unit for the reserach is the watershed of the Tiber River. The Tiber River watershed covers an area of 17,156 km^2. In it there are several natural and artificial lakes. Altogether, the area covered by the basin involves 6 regions, 14 provinces and 347 communes, and is comprised of vast areas of mountains or high hills, predominated by woods and pastures, and some middle-low hills and plains areas, where there are intensive farming and livestock activities, especially in the plains along the river and around the lakes. Pig-breeding is one of the most important among livestock activities, with an average of 420,000 head (1990) being raised in the basin. The highest concentration of animals (81%) in the basin are raised in the two Umbrian provinces of Perugia and Terni. The idea of converting MAP to italian, comes from all the things listed above and in section 4. First of all, the new trend in using manure as a fertilizer. Since there are different rules for manure application on the fields in the territory of almost every different local Environmental Protection Agency, it would be very important to make available a tool for manure management, that can give sound directions and recommendations for manure applications in all the regions. This would avoid that two close livestock enterprises, but one under an Environmental Protection Agency, and another one under another Agency, have to follow different rules for manure management, sometimes with serious economic damages, such as often happen in Italy. So, starting from swine, but in a second time extending to all livestock types, the Istituto di Estimo Rurale e Contabilita' of the University of Perugia, funded by the above mentioned CNR-RAISA, decided, together with the Center for Farm Financial Management, University of Minnesota, to convert MAP into Italian, to get an Italian version.

The first step in the conversion process involved translating into Italian all the input text, output text, and context-sensitive help messages. Translating the input and output text was accomplished using a software utility program called TRANSPAS. This utility program was developed at the Center for Farm Financial Management, and allows a person familiar with MAP to translate the text seen by the user without having to modify any of the MAP source code. Using this approach only one copy of source code is maintained, so any improvements or corrections made to MAP will be done for all language versions of the software. Translating the help messages simply involved editing the help document in a word processor such as WordPerfect or Microsoft Word.

The second step in the conversion process involved editing the MAP databases (Figure 2).

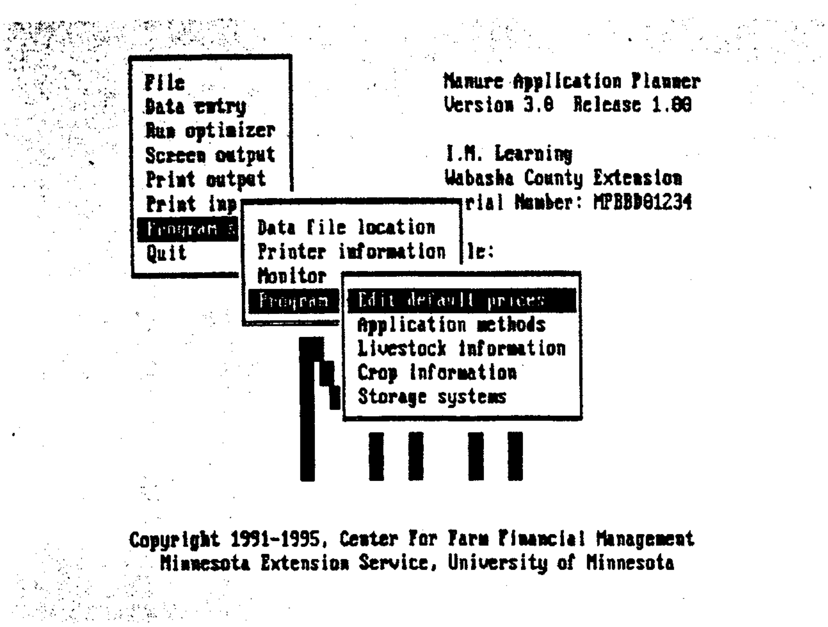

Figure 2: Map databases

MAP relies on databases to simplify user input, and these were changed for conditions in Italy. An individual user can still customize the databases for a particular region or farm situation.

6. Case Farm

The farm used for this test of the Italian MAP, is a typical farm of Umbria, with a livestock enterpriese, and not very much land, with some different types of crops. In this case, the livestock type is dairy. 70 dairy cows weighing 650kg, and 70 dairy calves, in different stage of weight are present in the farm. The land consists of 47 hectares, and main crops are listed in table 2.

Crops	Hectares
Corn	14.3
Barley	12.5
Sunflowers	2
Wheat	2
Vine	3.3
Olive tree	1.75
Alfalfa	8.6
Set-aside	2.55
TOTAL	**47**

Table 2: Crops and their area surfaces.

The breed of the cows is Holstein-Friesian. The animals weigh about 50 kg when they are born, and come to 650 kg when they are in full production.

The land is mostly flat, and the soil test remarks that it is clayely, with a good level of organic matter, N, P_2O_5 and K_2O.

The surface area of the farm is divided in 12 fields, and the distance from manure source vary from 20 meters to 3 kilometers. dairy manure is applicated on the fields, apart from the alfalfa field and the set-aside field. So, the available fields for manure application are 10.

The storage system for manure is above ground tank. The manure production has been estimated in 1680 t per year, and the nutrients content per unit of manure has been estimated in 3 kg of N, 1kg of P_2O_5 and 4 kg of K_2O.

After references, is enclosed the copy of the print of the input, that include manure sources, fields and input prices. Per each field it is indicated the name, surface area, crop, nutrient requirements. It is also indicated the result of the optimizer calculations, in terms of application method, manure rate, and distance from the source.

About the nutrient requirements, it must be underlined that it has been indicated only the removal rate of the crop, since the soil test have shown a very good nutrients content.

The print of the output is also enclosed after references. It shows per each field the application method selected by the optimizer, the manure rate, the amount of nutrients per hectare. All the fields need an addition of commercial fertilizer, especially for N and P_2O_5. The excess nutrient is very common for K_2O, but not for N and P_2O_5. The manure balance is zero, which means that all manure is used. It is very interesting to look at the source of nutrients: it comes out that most of the nitrogen required by crops is taken from commercial fertilizer, and also a good part of phospate. About the availability of nutrients, it depends upon the application method, so that there is a very different situation between broadcast, no incorporated and broadcast, incorporated in 12 hours, at least for nitrogen. For phospate and potash there are no differences.

Coming to the economic output, it comes out that for all the fields apart from no.4 and 5, the total cost per hectare of fertilization with manure is lower than without manure, even if the total for all the 35.85 hectares is a little higher for with manure situation (299,920 lire versus 294,611). This makes even more interesting and effective the use of manure for land fertilization. In fact, using manure is for sure, if well managed, a sustainable environmentally sound farming technique, and can help to solve the problem of manure disposal. If in addition it can be also valuable from the economic point of view, very similar to fertilization only with commercial fertilizer, it becomes extremely interesting for farmers.

MAP is the right tool to manage and monitor all these things, so that manure management can be not only a problem to solve, but also and mainly a way of organizing and optimizing farm resources.

7. Conclusions

As showed in the case farm, MAP can be used for setting up a manure application plan for farms. Thanks to this plan among the others, it is possible to avoid N excess, so that the risk of water and soil pollution can be minimized.

In Italy at present farmers with livestock enterprises are having very hard time, because there are not common regulations for manure management, and the Local Environmental Protection Agencies can close the enterprise at any time, if they find that manure is going to be a problem for the environment and human health. But definitely livestock is still a good source of income for farmers, so it would not make sense to close livestock enterprises to avoid the risk of problems with Environmental Agencies. Since MAP can optimize not only the economic aspect of manure management, but also the environmental side, it can become the guideline for manure application: if for example Local Environmental Protection Agencies would ask for an application plan, MAP could be used. The farmers would have only to respect what is in the MAP output, and they would not take any risk.

The intention of the Istituto di Estimo Rurale e Contabilita' and the Center for Farm Financial Mangement is not only to develop the Italian version for research aims, but they believe that this can be a practical tool, that can be very helpful and play a role for solving the problem of manure management in Italy.

The first step towards this goal will be the presentation of the Italian version of MAP to Extension Agencies, Local Environmental Protection Agencies, and Livestock Producers Associations, which most probably will be held in July. After that, a book on environmental impact of livestock and manure management enclosing a demo disk of MAP, will be diffused in Italy.

MAP is designed to solve a so specific problem, that it can really be the way to allow to farmers to have definite answers about the legitimacy of their activity, and to decision makers to have available a standard model and a control tool objective and equal for different areas.

All these considerations sound like a wish for MAP to meet a good impression by all the people working in the livestock sector, so that it will be able to give a real contibution to the solution of a very important problem for Italian agriculture.

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Manure Application Planner 3.0
Center For Farm Financial Management
(C)1995 University Of Minnesota
User: I.M. Learning
Wabasha County Extension

Azienda esempio
Passaggio di Bettona (PG)
File: PASSAGGI
Data: 12 Giugno, 1996

*** FONTI DELLE DEIEZIONI ***

Tipo allevamento	Bovini latte
Metodo stoccaggio	Vasca esterna
Descrizione	Frisone
Unita' di misura	t
Deiezioni disp.	1680 t
Kg N per unita'	3
Kg P2O5 per unita'	1
Kg K2O per unita'	4

Valori elem. nutritivi presi da analisi deiezioni?No

*** APPEZZAMENTI ***

Nome appezz.1 - Vigneto
Ettari 2,3
Coltura Vite

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	60	Metodo spandimento	Scelte modello
Minimo kg P2O5	100		
Massimo kg P2O5	120		
Kg K2O	120		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim. no interra.	100 t	0,02 km

- -

Nome appezz.2 - Campetta
Ettari 3
Coltura Mais

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	280	Metodo spandimento	Scelte modello
Minimo kg P2O5	70		
Massimo kg P2O5	80		
Kg K2O	52		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	100 t	0,05 km

- -

*** APPEZZAMENTI ***

Nome appezz.3 - Cerreto
Ettari 10,5
Coltura Orzo

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	120	Metodo spandimento	Scelte modello
Minimo kg P2O5	30		
Massimo kg P2O5	40		
Kg K2O	30		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	50 t	0,03 km

- -

Nome appezz.4 - Oliveto
Ettari 1,75
Coltura Olivo

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	100	Metodo spandimento	Scelte modello
Minimo kg P2O5	50		
Massimo kg P2O5	80		
Kg K2O	110		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	60,6 t	2 km

- -

Nome appezz.5 - Spaccio
Ettari 5,3
Coltura Mais

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	280	Metodo spandimento	Scelte modello
Minimo kg P2O5	70		
Massimo kg P2O5	80		
Kg K2O	52		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	64,3 t	2,5 km

- -

*** APPEZZAMENTI ***

Nome appezz.6 - Cappuccinelle
Ettari 6
Coltura Mais

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	280	Metodo spandimento	Scelte modello
Minimo kg P2O5	70		
Massimo kg P2O5	80		
Kg K2O	52		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	14,4 t	2,5 km

- -

Nome appezz.7 - Ballitto
Ettari 2
Coltura Frumento T.

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	180	Metodo spandimento	Scelte modello
Minimo kg P2O5	50		
Massimo kg P2O5	60		
Kg K2O	36		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	10 t	2,5 km

- -

Nome appezz.8 - Barca
Ettari 2
Coltura Orzo

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	120	Metodo spandimento	Scelte modello
Minimo kg P2O5	30		
Massimo kg P2O5	40		
Kg K2O	30		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	8,3 t	2,5 km

- -

*** APPEZZAMENTI ***

Nome appezz.9 - Luna
Ettari 1
Coltura Vite

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	60	Metodo spandimento	Scelte modello
Minimo kg P2O5	100		
Massimo kg P2O5	120		
Kg K2O	120		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	36,4 t	2 km

- -

Nome appezz.10 - Sole
Ettari 2
Coltura Girasole

Fabbisogno elem. nutr./ha		Vincoli del Modello	
Kg N	100	Metodo spandimento	Scelte modello
Minimo kg P2O5	45		
Massimo kg P2O5	55		
Kg K2O	33		

Fonte Deiezioni	Metodo Spandimento	Quantita'/ettaro	Dist. dalla fonte
Bovini latte	Spargim.int.< 12 ore	9,2 t	3 km

*** PREZZI ***

Fertilizzante Commerciale

Costo per kg N	990	
Costo per kg P2O5	805	
Costo per kg K2O	725	
Costo spandimento	35000	per ettaro

	Includere nel Modello?	Costo Per Tonnellata Spandimento	Costo Per Tonnellata Trasporto per km	Costo Per Metro Cubo Spandimento	Costo Per Metro Cubo Trasporto per km
Fertirrigaz. pioggia	No	-	-	-	-
Fertirrigaz. scorr.	No	-	-	-	-
Iniezione nel terr.	Si	9999999	9999999	2700	600
Spargim. no interra.	Si	2000	600	2000	600
Spargim.int.< 12 ore	Si	2500	600	2500	600
Spargim.int<4 giorni	Si	2500	600	2500	600

Manure Application Planner 3.0
Center For Farm Financial Management
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User: I.M. Learning
Wabasha County Extension

Azienda esempio
Passaggio di Bettona (PG)
File: PASSAGGI
Data: 12 Giugno, 1996

*** RIEPILOGO QUANTITA' DISTRIBUITE ***

Appezzamento	Ettari	Coltura	Metodo spandimento	Quantita'/ha	-- kg per Ettaro --- N	P2O5	K2O	kg N Anno 2
1 - Vigneto	2,3	Vite	Spargim. no interra.	100 t	60	80	360	75
			Fertilizzante commerciale		-	20	-	
2 - Campetta	3	Mais	Spargim.int.< 12 ore	100 t	165	80	360	75
			Fertilizzante commerciale		115	-	-	
3 - Cerreto	10,5	Orzo	Spargim.int.< 12 ore	50 t	83	40	180	38
			Fertilizzante commerciale		38	-	-	
4 - Oliveto	1,75	Olivo	Spargim.int.< 12 ore	60,6 t	100	48	218	45
			Fertilizzante commerciale		-	2	-	
5 - Spaccio	5,3	Mais	Spargim.int.< 12 ore	64,3 t	106	51	232	48
			Fertilizzante commerciale		174	19	-	
6 - Cappuccinelle	6	Mais	Spargim.int.< 12 ore	14,4 t	24	12	52	11
			Fertilizzante commerciale		256	58	-	
7 - Ballitto	2	Frumento T.	Spargim.int.< 12 ore	10 t	16	8	36	8
			Fertilizzante commerciale		164	42	-	
8 - Barca	2	Orzo	Spargim.int.< 12 ore	8,3 t	14	7	30	6
			Fertilizzante commerciale		106	23	-	
9 - Luna	1	Vite	Spargim.int.< 12 ore	36,4 t	60	29	131	27
			Fertilizzante commerciale		-	71	-	
10 - Sole	2	Girasole	Spargim.int.< 12 ore	9,2 t	15	7	33	7
			Fertilizzante commerciale		85	38	-	

*** ELEMENTI NUTRITIVI IN ECCESSO PER ETTARO ***

Appezzamento	Ettari	Coltura	kg N	kg P2O5	kg K2O
1 - Vigneto	2,3	Vite	-	-	240
2 - Campetta	3	Mais	-	10	308
3 - Cerreto	10,5	Orzo	-	10	150
4 - Oliveto	1,75	Olivo	0	-	108
5 - Spaccio	5,3	Mais	-	-	180
6 - Cappuccinelle	6	Mais	-	-	-
7 - Ballitto	2	Frumento T.	-	-	-
8 - Barca	2	Orzo	-	-	0
9 - Luna	1	Vite	0	-	11
10 - Sole	2	Girasole	-	-	-

*** RIEPILOGO COSTI ***

Appezzamento	Ettari	Coltura	Con deiezioni: Costo spandimento e trasp.deiez.	Con deiezioni: Costo fertilizzante commerciale	Con deiezioni: Costo totale per ha	Senza deiezioni: Costo fertilizzante commerciale	Senza deiezioni: Costo totale per ha
1 - Vigneto	2,3	Vite	462.760	117.530	252.300	602.370	261.900
2 - Campetta	3	Mais	759.000	446.550	401.850	1218750	406.250
3 - Cerreto	10,5	Orzo	1.321.950	757.313	198.025	2096850	199.700
4 - Oliveto	1,75	Olivo	392.424	63.384	260.462	444.500	254.000
5 - Spaccio	5,3	Mais	1.363.636	1176895	479.345	2153125	406.250
6 - Cappuccinelle	6	Mais	346.667	2013917	393.431	2437500	406.250
7 - Ballitto	2	Frumento T.	80.000	461.350	270.675	559.100	279.550
8 - Barca	2	Orzo	66.667	317.942	192.304	399.400	199.700
9 - Luna	1	Vite	134.545	92.082	226.627	261.900	261.900
10 - Sole	2	Girasole	78.833	298.696	188.765	388.300	194.150
Totali	35,85		5.006.483	5745658	299.920	10561795	294.611

*** FONTE DEGLI ELEMENTI NUTRITIVI DISTRIBUITI ***

Fonte	kg totali: N	P2O5	K2O
Bovini latte	2531	1344	6048
Fertilizzante comm.	3907	775	-

*** ANALISI ED UTILIZZAZIONE DELLE DEIEZIONI ***

Fonte	Unita'	kg per unita': N	P2O5	K2O	Deiezioni dispon.	Deiezioni distrib.	Bilancio
Bovini latte	t	3	1	4	1680	1680	0

*** DISPONIBILITA' DI ELEMENTI NUTRITIVI ***

Allevamento	Metodo spandimento	% N dispon. Anno 1	% N dispon. Anno 2	% N dispon. Anno 3	% P2O5 disponibile	% K2O disponibile
Bovini latte	Spargim. no interra.	20	25	15	80	90
	Spargim.int.< 12 ore	55	25	10	80	90