Input-output cost of agronomic production of crops under rotate growing condition for applying to Mediterranean Italian buffaloes

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ABSTRACT: Forage availability with low cost of production is the main farmer requisite for obtaining a competitive husbandry dairy product in the market. Cropping system for silage consumption differently impact the cost of Milk Feeding Unit (MFU) and sustainable agronomic cultivation of herbage production. The experiment aimed to assess the analytical cost of MFU per hectare in four forage cropping system models based on two crops per year bred under irrigated and rainfed condition in a Mediterranean site with intensive buffaloes breeding pressure.

Key words: Silage model, Growing input, MFU ha⁻¹, Unit MFU cost.

INTRODUCTION - In the area of Italian regions of Campania and Lazio, with high Mediterranean Italian buffaloes husbandry density, the main forage crops for silage production are made by cropping two species per year (winter Italian reygrass, Lolium multiflorum Lam. and spring corn, Zea mays L.) (Mengoazzi, 2003). Dairy farmer, for reducing the cost of the herbage production tills crops with simplified and low cost of agronomic techniques. The availability to find on the market adapted genotypes to environment and the easy possibility to rent mechanical equipment for silage processing, were the factors that mainly encourage the growing of Italian reygrass-corn cultivation (Caballero, 1993). The facilities achieved by Italian reygrass-corn monoculture promote the cultivation of the crops for silage production instead rotation cropping systems which favour sustainable agriculture able to reduce the impact of cultivation on soil pollution (Pierce and Rice, 1988; Martiniello, 2007). Thus, rotation of crops based on legume instead monoculture of Italian reygrass-corn was an agronomic approach able to reduce the impact of dairy production on the environments. The study based on determination of economic costs of MFU, produced by traditional cropping system compared with those of rotations, stand out the economic discrepancy existing among the models.

The aims of the paper intend to determine and compare the input cost of MFU unit of
husbandry farmer to produce silage for Mediterranean Italian buffaloes in four cropping systems established under irrigated and rainfed condition of growing.

**MATERIAL AND METHODS** - The experiments were established at Foggia (15° 13'E, 41° 18'N and 76 m above see level) in 2006 and still are in progress. The trails evaluated 4 models under irrigated and rainfed condition of growing. Each model consider two crops per year whose sowing was made in autumn and spring. The crops and the varieties used in the model were reported in Table 1.

The crops of each model are sown in winter or summer seasons, harvested and the gross product stored in barns the kernel and in silage the biomass. The cost of production for growing the winter and summer crops are referred to phase of growing of the vegetative cycle: pre-sowing (mouldboard plough, fertilization, smoothing soil with field cultivator and tine-harrow and seed-sowing by driller), crop-growing (fertilization, weeding, irrigation) harvest-storage

**Table 1.** Winter and spring crops considered in the models of the irrigated and rainfed treatments.

| Type of Model | WINTER MODEL UNDER IRRIGATED | SPRING MODEL UNDER IRRIGATED |
|---------------|-----------------------------|-----------------------------|
| Crops Variety | Lucerne Bella                | Lucerne Bella               |
|               | Reygrass Andrea             | Corn Azuaga                 |
|               | Baley Marado                | Regulus Nicol               |
|               | Bean Vesuvio                | Sorghum Nicol               |

| Type of Model | WINTER MODEL UNDER RAINFED | SPRING MODEL UNDER RAINFED |
|---------------|-----------------------------|-----------------------------|
| Crops Variety | Clover Local Ec.            | Sorghum Regulus             |
|               | Reygrass Andrea             | Sorghum Nicol               |
|               | Barley Arda                 | Sorghum Regulus             |
|               | Pea Susan                   | Sorghum Nicol               |
|               | Sorghum Regulus             | Sorghum Nicol               |
|               | Sorghum Regulus             | Sorghum Nicol               |

(kernel-threshing in barn and biomass-copping in silage). The crops are grown adopting the appropriate agronomic practices whose cost, for phase of cultivation, are reported in Table 2. The cost of specific agronomic practices was determined by making inquire about the rent with a marketing research and comparing, when it is possible, with the price scheduled by the list of trade union category. The sowing rainfed spring crops, for favouring establishment seedling, was applied an aid irrigation after sowing. The crops under irrigation treatments, were irrigated when evaporation (ETo) from the crops reached 80 mm. The water supplied by irrigation was 800 m³ ha⁻¹. During the vegetative cycle of crops was made 8 irrigations for corn and 5 for sorghum. The harvest of crops for kernel consumption (hors bean and pea), hay (clover and lucerne) and for silage (corn, barley, reygrass) were made at appropriate phenological stage. The parameters determined were biomass production, yield components (stems m⁻², harvest index, seed per fructiferous organ) and a sample for chemical analyses (crude protein and fibre, acid and neutral detergent fibre, acid detergent lignin, starch, fatty acid and ashes). The milk feeding unit (MFU) was computed according to Chase (1981) procedure.
RESULTS AND CONCLUSIONS - The crops included in the models of rainfed condition are all annuals while those of irrigated condition consider annuals and perennial meadow of lucerne. The costs of growing under irrigated was 27.1% lower than rainfed condition (Table 2). The difference existing between costs (47.2%) in the spring models of irrigated and rainfed condition was mainly due to the charge of water irrigation to the crops (Table 2). Among the spring models under irrigated, the costs of corn and sorghum was 38.9% and 48.5% lower than lucerne meadow (Table 2). The cost of growing under irrigated winter condition of graminaceous (reygrass and barley) excides those of legume as consequences of higher cost of fertilization (100 € for nitrogen plus 20 € for distribution) and those of harvesting the gross products (threshing seed about 70% lower than copping biomass). The higher cost of model I of meadow than other models (corn and sorghum) was ascribed to the wider cost of hay making process (245 € ha\(^{-1}\) for harvest ) rather than silage (185 € ha\(^{-1}\)) (Table 3). The cost of MFU unit of winter models under rainfed and those of irrigated condition were quite similar. The model II of irrigated and model VIII of rainfed condition based, respectively on corn and sorghum presented lower cost of MFU than other models (Table 3). Furthermore, winter irrigated model IV and rainfed model VIII, because based on legume crops presented higher cost of MFU than the models based up grasses crops. The cost of MFU unit of model II under irrigation was lower 36.9, 15.4 and 26.7 than, respectively models: I, III and IV while under rainfed the cost of MFU of the model VIII was 10.9 % lower than mean of other models (Table 4). Preliminary results evidenced that the crops of model II (Italian reygrass-corn) under irrigated condition and those of model VIII (pea-sorghum) under rainfed were the models able to produce the MFU at lower cost than others cropping systems.

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Table 2. Costs of the agronomic practices of the phase of growing in the crops of the models.

| Phase of crop growing | CROPS PRODUCTION COST (€ ha\(^{-1}\)) IN WINTER MODEL UNDER IRRIGATED | CROPS PRODUCTION COST IN SPRING MODEL UNDER IRRIGATED |
|-----------------------|---------------------------------------------------------------|-----------------------------------------------------|
|                       | Model I | II | III | IV | Model I | II | III | IV | Model I | II | III | IV | Model I | II | III | IV | Model I | II | III | IV |
| Pre-sowing            | -----   | 353 | 336 | 296 | 357     | 353 | 358 | 358 | 358     | 353 | 358 | 358 | 358     | 353 | 358 | 358 | 358     | 353 | 358 | 358 |
| Crop-growing          | -----   | 184 | 211 | 171 | 705     | 654 | 526 | 526 | 526     | 526 | 526 | 526 | 526     | 526 | 526 | 526 | 526     | 526 | 526 | 526 |
| Harvest-storage       | -----   | 248 | 247 | 75  | 1281    | 424 | 334 | 312 | 312     | 312 | 312 | 312 | 312     | 312 | 312 | 312 | 312     | 312 | 312 | 312 |

| Phase of crop growing | CROPS PRODUCTION COST (€ ha\(^{-1}\)) IN WINTER MODEL UNDER RAINFED | CROPS PRODUCTION COST (€ ha\(^{-1}\)) IN SPRING MODEL UNDER RAINFED |
|-----------------------|---------------------------------------------------------------|-----------------------------------------------------|
|                       | Model V | VI | VII | VIII | Model V | VI | VII | VIII | Model V | VI | VII | VIII | Model V | VI | VII | VIII | Model V | VI | VII | VIII |
| Pre-sowing            | 250     | 353 | 296 | 296   | 353     | 353 | 353 | 353   | 353     | 353 | 353 | 353 | 353     | 353 | 353 | 353 | 353     | 353 | 353 | 353 |
| Crop-growing          | 230     | 184 | 171 | 171   | 185     | 185 | 185 | 185   | 185     | 185 | 185 | 185 | 185     | 185 | 185 | 185 | 185     | 185 | 185 | 185 |
| Harvest-storage       | 256     | 238 | 246 | 75    | 270     | 283 | 276 | 285   | 276     | 283 | 276 | 285 | 276     | 283 | 276 | 285 | 276     | 283 | 276 | 285 |
Table 3. Total MFU ha-1 and costs of cultivations of the crops in the winter and spring models.

| Model                  | Winter Model Under Irrigated | Spring Model Under Irrigated |
|------------------------|-----------------------------|-----------------------------|
| MFU ha⁻¹ (n.)          |                             |                             |
| Model                  | I | II | III | IV | I | II | III | IV |
| Total costs of cultivation (€) | 785 | 794 | 542 | 2343 | 1431 | 1218 | 1196 |
| Production Cost MFU (€) | 0.297 | 0.145 | 0.974 | 0.157 | 0.073 | 0.104 | 0.157 |

Table 4. Unit cost of MFU in the models of the irrigated and rainfed condition.

| Model                  | Winter Model Under Rainfed | Spring Model Under Rainfed |
|------------------------|-----------------------------|-----------------------------|
| MFU ha⁻¹ (n.)          |                             |                             |
| Model                  | V | VI | VII | VIII | V | VI | VII | VIII |
| Total costs of cultivation (€) | 736 | 775 | 712 | 542 | 808 | 821 | 814 | 823 |
| Cost MFU (€)           | 0.216 | 0.314 | 0.237 | 0.886 | 0.124 | 0.114 | 0.124 | 0.091 |

REFERENCES - Caballero, R., 1993. An experts survey on the role of forage legumes in arable cropping systems of the Mediterranean area. Journal Sustainable Agriculture, 3: 133-154. Chase, L.E., 1981. Energy prediction equation in USA at the NY DHIG Forage Laboratory. Proceeding Production Agricultural Training School 9: 9-13. Martiniello, P., 2007. Biochemical parameters in a Mediterranean soil as effected by wheat-forage rotation and irrigation. European Journal Agronomy, 26: 198-208. Mengozzi, B., 2003. Mozzarella di bufale urge un'offerta più concreta. Informatore Zootecnico, 7(34): 34-37. Pierce, F.J., and Rice C.W., 1988. Crop rotation and its impact on efficiency of water and nitrogen use. In: Hargrove, W.L. (ed.), Cropping strategies for efficient use of water and nitrogen. Pub. 51, ASA, SSSA, CSSA, Madison WI, USA, pp. 21-42.